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INNOVATIVE APPROACHES AND METHODS OF INCREASING THE TECHNICAL LEVEL MACHINES AND UNITS

Olena Trukhanska, PhD, Associate Professor
Vinnytsia National Agrarian University

Труханська Олена Олександрівна, к.т.н., доцент
Вінницький національний аграрний університет

Wear of parts is accompanied by a decrease in performance, especially with long-term use of machines, which causes deterioration in product quality.

The growth of the equipment of agricultural production with more advanced equipment, the conduct of integrated mechanization and increase the efficiency of equipment is developing, changing and repair production. The development of the field of restoration of worn parts is based on close cooperation of repair production with branch and basic science, and achievement of scientific and technical progress.

Deepening the method of group recovery technology to create a unified group equipment for surface restoration is a promising area of restoration technology in organizational terms. A large number of restored machine parts are discarded due to low wear of working surfaces, amounting to one percent of the initial weight of the parts. Research has proven and practically confirmed that the restoration of machinery, machines, and mechanisms is technically impossible to avoid, but on the other hand the restoration is economically feasible. The restored part serves the same term as the new one, and may exceed the service life of the new part.

The paper presents the results of research on the performance characteristics of coatings obtained by the developed technology. These studies were aimed at improving the quality of coatings that are restored by electro contact cauterization, namely to obtain uniform physical and mechanical properties in the cross section of the coating. The result is an upgraded technology, which involves cauterization of the powder with an electrode with a shaped contact surface with simultaneous surface plastic deformation of the surface.

Key words: *restoration, surface deformation, wear resistance, shaft, spraying, powder material, equipment.*

Fig. 3. Ref. 6.

1. Problem formulation

Studies related to the improvement of the technology of electro contact cauterization of powder materials in the restoration of "shaft" parts indicate the widespread use of this method in many industries [1].

The research data were aimed at improving the quality of the coating obtained by electro contact cauterization, namely to obtain uniform physical and mechanical properties in the cross section of the coatings. The result of these studies was an upgraded technology involving the cauterization of powder with an electrode (surface plastic deformation) with a shaped contact surface with simultaneous surface plastic deformation of the surface (coating in one technological cycle with cauterization: electro contact cauterization of powder materials in surface plastic deformation) [1, 2].

2. Analysis of last researches and publications

It is determined that the combined coating process should be used to restore cylindrical parts that operate in the conditions of marginal, abrasive and hydro abrasive lubrication [1-3]. The amount of wear that can be restored in this way can be in the range of 0.05-1.5 mm, the hardness of the coating can reach 30-70 HRC depending on the powder material. Diffusion-doped composite powder, Fe-B-C systems with spherical particles with a size of 60-100 μm and a diffusion shell thickness of 10-15 μm were used as powder material in the research. The hardness of the obtained coatings was 50-52 HRC. The results of researches of operational characteristics of coverings received on the developed technology are resulted [3].

In solving the problem of increasing the durability of machine parts, the most important role is played by the antifriction properties of the applied coatings: wear resistance, friction coefficient, the possibility of running ets.

3. Aim of the researches

Improving reliable operation and ensuring high strength of restored parts by applying wear-resistant coatings.

This provision is one of the main requirements for repair production.

4. Results of the researches

It is known that friction units create conditions that provide oil to the friction zone, but under certain operating conditions there may be a direct collision of friction surfaces, the so-called "dry" friction, which can lead to setting of the friction surfaces. In this regard, the surfaces of hardened steel 45 and coatings obtained by the combined technology of electrocontact cauterization of powder materials during surface plastic deformation were studied.

The MI-1M friction determination machine was used to study the characteristics of friction surfaces without lubrication and at the maximum friction from the specific load and sliding speed [4].

Experimental values of linear wear depending on the duration of the tests without lubrication and at the maximum friction are presented in (Fig. 1).

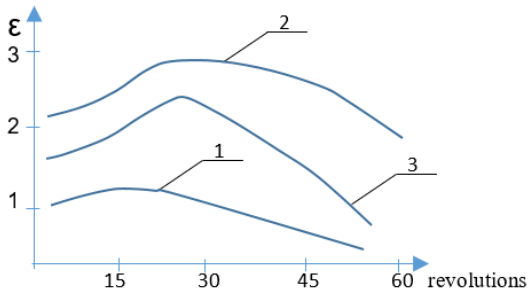

Fig. 1. Relative wear resistance depending on the time of operation of the coupling: 1 - sample of hardened steel 45; 2 - sample with coating (with maximum lubrication); 3 - sample with coating (without lubrication).

From the graphs (Fig. 1) it is seen that the samples of coatings obtained by the developed technology have a wear resistance of 1.7-3 times higher than the reference sample of hardened steel 45.

The study was performed at a specific load of 0.5 MPa and a sliding speed of 0.5 m / s without lubrication and when applying oil to the friction zone. The linear wear of the samples was determined after every 5000 rpm, which corresponded to 628 m of the friction path. The total duration of the exams covered both the run-in period and the period of permanent wear. In each experiment, in addition to linear wear, the moment of friction was recorded.

The results of comparative tests showed that after 50,000 revolutions, the wear process, both in conditions of extreme friction and without. lubrication, occurs with constant intensity. Therefore, the obtained results of wear after 50,000 revolutions of the roller were used to compare the wear resistance of the surfaces of the studied samples [4].

The reason for high wear resistance is the favorable ratio of micro hardness of the structural components of the layer when using DL powders and improving the conditions of surface lubrication.

The porosity, which remains in the coating and can be 5-12%, contributes to the retention of oil in the surface layer. The macro geometry formed as a result of use of a profile electrode provides a qualitative supply and uniform distribution on the contact area of lubricant. The helical nature of the grooves in the restoration of cylindrical parts contributes to the formation of the oil wedge and the removal of wear products from the friction zone.

Plastic deformations in the processing of metals by pressure are the main factor in the formation of macro geometry and micro geometry. As a result of pressure of rollers on metal of a surface layer there is a plastic deformation of rough nesses of a surface, their smoothing and flow of metal from ledges in hollows. This changes the shape and direction of the inequalities and reduces their magnitude to lower values.

The helical groove on the surface of the part allows you to keep the oil during the operation of the coupling, apply it under some pressure to the friction zone and distribute more evenly on the friction surfaces. The openness of the groove (ie the possibility of free release of oil) improves the flow of oil in contact with the surfaces and ensures the removal of wear products from the friction zone.

In order to study the coatings in working conditions, a batch of experimental camshafts of the engine was restored according to the developed technology with coating on the support necks, and a batch of shafts restored according to the technology of vibroarc surfacing was selected.

Checking the efficiency of parts restored by the developed technology was performed on stands and in operating conditions [5].

During operation, the support necks of the engine camshaft are lubricated under the pressure of the oil flowing through the channels of the crankcase. They work in conjunction with plain bearings in the conditions of hydro abrasive

wear. During the operation of the shaft on the support necks are cyclic loads that accelerate its wear, and sometimes lead to bending of the shaft. As a result of the wear process, the support neck becomes oval or conical. The wear of the support neck in diameter can reach 0.1-0.15 mm, after which the shaft is discarded or restored.

The main methods of repairing the camshaft support necks are grinding to the repair size. Worn necks of the last repair size are restored by vibro-arc surfacing with a high-carbon steel electrode.

Restoration of worn parts by vibro-arc surfacing has a number of advantages over other methods of recovery: low voltage at which the process takes place and intermittent nature, which allows surfacing at low depths of heating the part, almost without deformation. However, the appearance of internal stresses in the deposited layer and the possibility of microcracks due to intensive cooling lead to a decrease in fatigue strength of the part, which negatively affects the performance of parts operating under alternating loads [6].

Comparisons of experimental and serial camshafts, as well as sleeves that are coupled to the support necks, were performed before and after the tests by external inspection and by measuring the amount of wear of couplings using universal measuring instruments: measuring centers type PBM-500, micrometer, hour meter, indicator. The control was performed in two mutually perpendicular planes and in two sections, as shown in (Fig. 2).

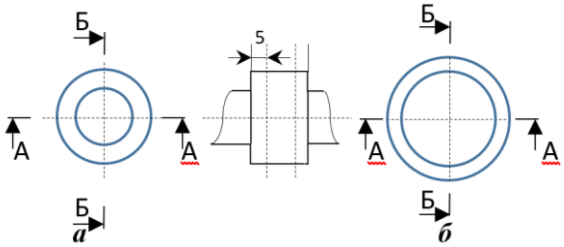

Fig. 2. The scheme of measurement of wear of the worked details: a - a shaft; b - bushing.

The results of studies of wear resistance of the conjugation are presented in (Fig. 3).

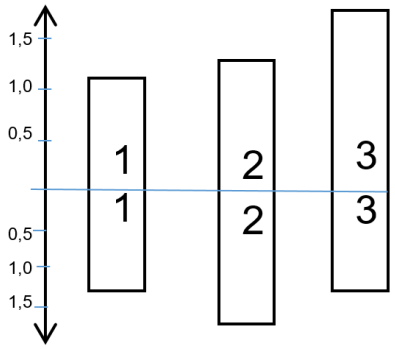

Fig. 3. Diagram of wear intensity $\times 10^{-5}$ ***m/1000 km: 1 - new parts; 2 - parts restored by vibroarc surfacing; 3 - parts restored by combined technology.***

As can be seen from the diagram (Fig. 3), the necks, restored by the developed technology, wear less intensively than new ones, and are restored by surfacing. The increase in the intensity of wear of the sleeve is due to the open porosity, which is always present when using powder materials, as well as uneven microhardness of the material.

Increasing the wear resistance of the camshaft occurs:

- due to the use of wear-resistant materials (namely diffusion-doped powder of the system Fe-B-C;
- due to the uniform distribution of physical and mechanical properties over the width of the coating and the favorable nature of the residual stresses inherent in electrocontact sintering;
- by improving the lubrication conditions that arise from the additional supply of oil through the channels remaining when using the electrode with a curved contact surface, and the flow of oil in the situation of extreme friction from the pores that occur when coating with electrocontact sintering.

In this case, the porosity is a technological factor in improving the reliability of friction parts, due to improved lubrication or anti-burst resistance of steam.

The porous surface, saturated with oil, is self-lubricating; monomolecular layer on the working surface is easily formed due to the high mobility of surfactants contained in the oil. A thicker boundary film is formed due to the inflow of oil from the pores due to the thermal expansion of the gases closed in the pores. Increasing the bearing temperature automatically causes additional oil to enter its outer surface; when cooled, the remaining oil is absorbed into the bearing.

The process of liquid friction in a bulk material bearing is different from the process in a monolithic liner. In the area of high pressure of the lubricating layer, the oil is partially pushed into the walls, which leads to its leakage from the area of low pressure. At low speeds and high loads, the transition from fluid to semi-liquid friction in a bulk material bearing is slower than in a monolithic bearing.

Insufficient lubrication in the hydrodynamic bearing reduces the thickness of the lubricating layer at low sliding speeds and limited bearing capacity.

5. Conclusions

Therefore, as a result of the research it was established and determined that the parts restored by electrocontact cauterization of diffusion-doped powder with a shaped electrode with simultaneous plastic deformation of the surface have wear resistance 1.7-2 times higher than new parts and 1.2 times higher than shafts restored by vibroarc surfacing, to restore a significant number of parts and give them physical and mechanical properties that can't be obtained by other methods and makes it highly expedient in wide application.

ІННОВАЦІЙНІ ПІДХОДИ ТА МЕТОДИ ПІДВИЩЕННЯ ТЕХНІЧНОГО РІВНЯ МАШИН І АГРЕГАТІВ

При довготривалому використанні машин зношування деталей супроводжується зниженням експлуатаційних показників, що викликає погіршення якості виробів.

Підвищення показників надійності і термінів служби машин, вузлів, агрегатів є важливим чинником зменшення витрат на відновлення деталей. Впровадження новітніх технологій сільськогосподарського виробництва, а також постійне сучасне удосконалення, ускладнення сільськогосподарської техніки є природним результатом її розвитку.

Розвиток галузі відновлення зношених деталей базується на тісній взаємодії ремонтного виробництва з галузевою та фундаментальною наукою, досягненнях науково-технічного прогресу. Метод групової технології відновлення для поверхневої реставрації є перспективним напрямом в організаційному відношенні. Проведеними дослідженнями доведено, що технічно неможливо уникнути відновлення машин, машин, механізмів, а відновлена деталь служить такий же термін, як і нова. Технології відновлення деталей відносяться до більш ресурсозберігаючих у порівнянні з виготовленням нових деталей. Розвиток галузі відновлення зношених деталей базується на тісному співробітництві ремонтного виробництва з галузевою і фундаментальною наукою, та досягнення науково-технічного прогресу.

У роботі наведено результати досліджень експлуатаційних характеристик покриттів, отриманих за розробленою технологією. Ці дослідження були спрямовані на підвищення якості покриттів, що відновлюються електроконтактним припіканням, а саме отримання однорідних фізико-механічних властивостей у поперечному перерізі покриття. Перспективним напрямком технології відновлення в організаційному плані є поглиблення методу групової технології відновлення створення уніфіковано-групового оснащення для відновлення поверхонь.

Ключові слова: *відновлення, поверхнева деформація, зносостійкість, вал, напилення, порошковий матеріал, оснастка.*

Рис. 3. Літ. 6

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INFORMATION ABOUT THE AUTHOR

Olena Trukhanska – Ph.D, Associate Professor of the Department of "Agroengineering and Technical Service" of the Vinnytsia National Agrarian University (Sonyachna St.3, Vinnytsia, 21008, Ukraine e-mail: seaswallow@ukr.net, https://orcid.org/0000-0001-8481-8878).

Труханська Олена Олександрівна – к.т.н., доцент кафедри «Агроінженерії та технічного сервісу» Вінницького національного аграрного університету (вул. Сонячна, 3, м Вінниця, 21008, Україна, e-mail: seaswallow@ukr.net, https://orcid.org/0000-0001-8481-8878).