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Pryvedenы эksperymentalnыh of research results in the production of biogas postepennoy Loading substrate. Opredelena dependence Medium Exit at postepennoy innings biogas substrate from the substrate obnovlyaemoho percent.

Biogas, methane tanks, kosubstrat, postepennaya Loading, sыroy glycerin, cattle manure, byohazovыy reactor.

The results of experimental studies of production of biogas at gradual loading of substrate. Determining the dependence of average yield of biogas at gradual supply of substrate from substrate percent updated.

Biogas digester, cosubstrate, progressive loading, crude glycerin, cattle manure, biogas reactor.

UDC 631.51.4

PERFORMANCE PARTS RESTORATION plunger fuel pump AGRICULTURAL MACHINERY

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The results of investigations of the properties and sizes of parts plunger recovery after nitriding, oksinitruvannyam, karbonitruvannyam and rotary chrome.

Plunger vapor recovery methods, properties, increase in size.

Formulation of the problem. Up to 50% of faults in diesel engines pryhodyatsya fuel equipment. In the most severe operating conditions plunger pairs fuel pumps due to dynamic loads and high pressure, the presence of corrosive and abrasive component parts in the fuel, wear and tear.

Due to the large number plunger and the complexity of their manufacturing advisable to restore detail, providing necessary technical conditions for their properties.

Analysis of recent research. Restoring precision pluzhennyh pairs, wear them tens of micrometers, there is a real opportunity to

increase the size of the parts in chemical and thermal methods of hardening.

So in [1] found that gas nitriding provided to increase the size of steel SK45 5 to 13 mm, and steel 41Cr4-10 ... 28 microns. This improvement made after the nitriding greater increase than after normalization. Microhardness surface reached 6,000 ... 11,000 MPa depending on the composition of steel. Karbonitruvannya at a temperature of 570 ° C, 6 hours. increases the diameter of steel samples for SK45 26 ... 29 microns, and stainless steel 41Cr4 14 ... 18 microns.

Cementation [2] also leads to increase in size details. So the plate of low carbon steel with thickness 10mm after cementation at a temperature of 910 ° C for 8 hours. given the increase in the size of 50 microns, high delivery the next - 60 microns, and after quenching and low tempering - 75 microns. In hromonikelmolibdenovoyi steel rods with a diameter of 10 mm increase in diameter was respectively 35, 50 and 55 microns.

A significant increase in the size of parts provides Boriding. It was established [3] that Boriding 25H5M5A steel in molten borax boron carbide at temperatures 950 and 1000 ° C for 2, 4 and 6 hours. gave diametrical increase sample size of 28 ... 56 mm. The largest increase (56 ... 58 m) gives Boriding for 6 hours. Boriding at a temperature of 1050 ° C for 6 hours. gives a significant boost to 108 mm diameter. However, after Boriding a temperature of 950 ° C followed by heat treatment increase the size of the samples of steel 25H5MA smaller and is 18 ... 24 mm, and after Boriding at temperatures 1000 and 1050 ° C such gains even smaller - only 4 ... 18 microns. Mathematical dependence increase the size of steel and cast iron parts after Boriding were 10, 30, U8, SHH15, HVG depending on the temperature of the process is shown in [4]. Boriding also increases the wear resistance of steel 25H5MA 2 ... 3 times, and the next after Boriding, hardening increases the wear resistance of 3.5 ... 5 times. In addition to chemical and thermal recovery methods used zhelezneniem, elektronatyrannya plating, chemical nickel [5], which is not recommended because of their low wear resistance. Galvanic plating of one of the effective methods to restore the plunger, which provides wear resistance of parts higher than the new [6].

Choose how to restore the plunger is determined not only the achievement of the required size but also providing increased wear resistance due to the hardness (microhardness) dispersion of carbides, borides and others. solid components of the structure of the surface layer.

Durability plunger also depends on the optimal combination of structure and material properties of conjugated parts, and especially their

surface layers [7]. Highest durability is achieved by a combination of dissimilar materials such as chrome and electrical nitrided steel that prevents shvachuvannyu friction surfaces. For optimum combination of properties of parts hardness (microhardness) conjugated surfaces should be different for HB 50 ... 100.

Therefore necessary to check the possibility of restoring plunger nitriding, Boriding and other means of chemical and thermal processing and use of electrolytic plating parts with a pair of coupling.

The purpose of research. Comparison of properties of parts plunger fuel pumps of diesel engines after nitriding, oksinitruvannya, karbonitruvannya and rotary plating to select the most effective ways and modes of providing the required mechanical properties and dimensional characteristics of renewable components.

Results. It studies the wear plunger fuel pumps fuel pump MD-60, which act at overhaul (Table. 1).

1. Wear parts plunger pumps.

Detail	Operation to overhaul microns	
	maximum	average
plunger	10	8
Bushing	14	12
dosimeter	5	5

Details plunzhernoj pair of pumps fuel pump MD-60 made of steel 25H5M. In the process of manufacturing these parts subjected to nitriding in two stages: the first stage is 510 ... 520 ° C, 30 h degree of dissociation of 20-35%; 2nd stage - 550 ... 560 ° C, 31hod, degree of dissociation 40 ... 60% ammonia cooling at 150 ° C, then the air. After nitriding surface hardness NV 8500; core HRC 20 ... 26 nitrided layer depth of 0.25 ... 0.50 mm. The data (Table. 1) show that the maximum wear of the fuel pump plunger pumps MD-60 reached 5 ... 14 microns, with high hardness friction surfaces.

So in terms of durability plunger is advisable to use recovery methods that provide high hardness of the surface layers and increase the size of their larger parts wear, ensuring their recovery. Studies were performed on wearing parts plunger pump fuel pump MD-60, which are subjected to gas and liquid nitriding, karbonitruvannyu, oksykarbonitruvannyu to ensure efficiency and quality of recovery. Re plunger pumps MD-60 is also subjected to rotary chrome. After the restoration of details outlined ways to change their main dimensions are shown in the table. 2.

2. Resize the restored parts plunger, um.

numb er lit.	Method and recovery mode	Increasing the diameter of the plunger	Reducing the diameter of the hole	
			case (bushings)	dispenser
1	2	3	4	5
1	Factory mode	12 ... 19	11 ... 21	8 ... 12
2	Nitriding the pace ture 500 ... 520 ° C; degree of dissociation of ammonia 20 ... 40%; duration - 26 hours	3 ... 6	9 ... 14	12 ... 16
3	Those conditions; duration - 52 hours.	8 ... 10	9 ... 18	5 ... 18
4	Those conditions; duration - 78 hours.	10 ... 18	10 ... 24	10 ... 11
5	Nitriding rate for eratury 590 ... 610 ° C; degree of dissociation of ammonia 40 ... 60%; duration - 5 hours; cooling oil	20 ... 45	26 ... 37	18 ... 45
6	Those conditions; duration - 6 hours	30 ... 36	20 ... 32	10 ... 37
7	Cyanidation melt 32% NaCNO, 38% KCl and 30% Na2CO3 per ton-ri 560 ... 580 ° C - 5 hours	9		
8	Those conditions duration of 8 hours	12		
9	Those conditions duration of 10 hours	10		
10	Oksykarbonitruvannya as ammonia, carbon dioxide and blowing steam per ton-ri 620 ... 640 ° C - 7 hours. Cooling oil	18 ... 30	51 ... 54	13 ... 16

Continued Table. 2

1	2	3	4	5
11	Karbonitruvannya into ammonia and carbon dioxide per ton-ri 600 ... 620 ° C - 8 hours. The cooling in the furnace. The degree of dissociation of ammonia 40 ... 60%	37 ... 38	40 ... 53	15 ... 18
12	rotary chrome plunger for t ry 57 ... 58 ° C; I = 50A / dm2, U = 6 ... 12V; duration - 60 minutes.	48 ... 50		

According to Table. 2 nitriding parts plunger for factory mode provides an increase in the diameter of the plunger 12 ... 19 mm, reducing the diameter of the aperture 11 of the case ... .21, dispenser 8 ... 12 microns, which is slightly higher than their allowable wear when you receive a repair (14 microns).

Nitriding at a temperature of 500 ... 520 ° C with increasing duration of 26 to 78 hours. gives a slight increase in the average diameter of the plunger 4 to 14 microns, reducing the diameter of the holes in the housing 12 and dispenser ... 15 10 ... 12 microns. Whereas nitriding for mechanical processing factory mode and at a temperature of 500 ... 520 ° C did not provide details of the restoration plunger.

Cyanidation plungers lasting from 5 to 10 hours gave diameter plunger increase by only 9 ... 12 microns, which is less than the limit wear and also suitable for their recovery.

Among the investigated ways to restore parts plunger is most effective nitriding temperature of 590 for details ... 610 ° C for 5 hours, and oksykarbonitruvannya karbonitruvanni and for plungers and rotary plating.

Excess increase the size of parts after recovery methods at their maximum wear to overhaul shown in Table. 3.

3. The difference between the change in diameter of parts plunger pump fuel pump MD-60 and a maximum of wear to overhaul microns.

Method of recovery	Increase the diameter of the plunger	Reduced diameter	
		case	dispenser
Nitriding at a temperature of 590 ... 610 ° C, 5 hours.	10 ... 35	12 ... 23	13 ... 30
oksykarbonitruvannya	8 ... 20	37 ... 40	8 ... 11
karbonitruvannya	27 ... 28	26 ... 29	10 ... 13
rotary chrome	38 ... 40		

Data Table. 3 indicate adequate supply growth coupled diameters of surfaces plunger fuel pumps for diesel engines of recovery after repair.

To assess the quality restoration parts plunger microhardness measured their working surfaces that are listed in the table. 4.

4. Microhardness working surfaces plunger.

Method of recovery (strengthening)	name details	Microhardness, MPa
Nitriding for factory mode	new plunger	7930
Nitriding for factory mode	worn plunger	8350
Nitriding mode for factory worn plunger	plunger restored	7930

Nitriding at a temperature of 590 ... 610^{at}C 5 hours	plunger	5720
	Corps	5530
Aksykarbonituvannya	plunger	6770
	Corps	7180
Karbonitruvannya	plunger	6110
	Corps	8240
rotary chrome	plunger	9560

According to research (tab. 4) new, worn plungers and restored to factory mode with the surface microhardness 7930 ... 8350 MPa. Recovery for nitriding temperature 590 ... 610^{at}C provides a slightly lower microhardness surface of the plunger and the housing, which is 5530 ... 5720 MPa.

This is due to the higher temperature nitriding process. But as shown by experiments [1] made on nitrided steels 28HMYUA and 40X that nitriding at higher temperatures (620^{at}C) are far superior wear resistance of these steels, nitrided at temperatures 560^{at}C, though with less strength.

Oksikarbonitruvannya provides microhardness working surfaces of the plunger and the housing close to the nitrided mode for factory parts.

Karbonitruvannya plunger made smaller microhardness 6110 MPa working surface, while the surface of the hull was relatively high microhardness of 8240 MPa.

The highest microhardness restored 9560 MPa surface of the plunger was reached after plating rotor.

To evaluate the properties of recovered parts in the surface layer of micro hardness measurement conducted in their section.

Micro hardness measurement results in section remanufactured parts are shown in Fig. 1 and Fig. 2.

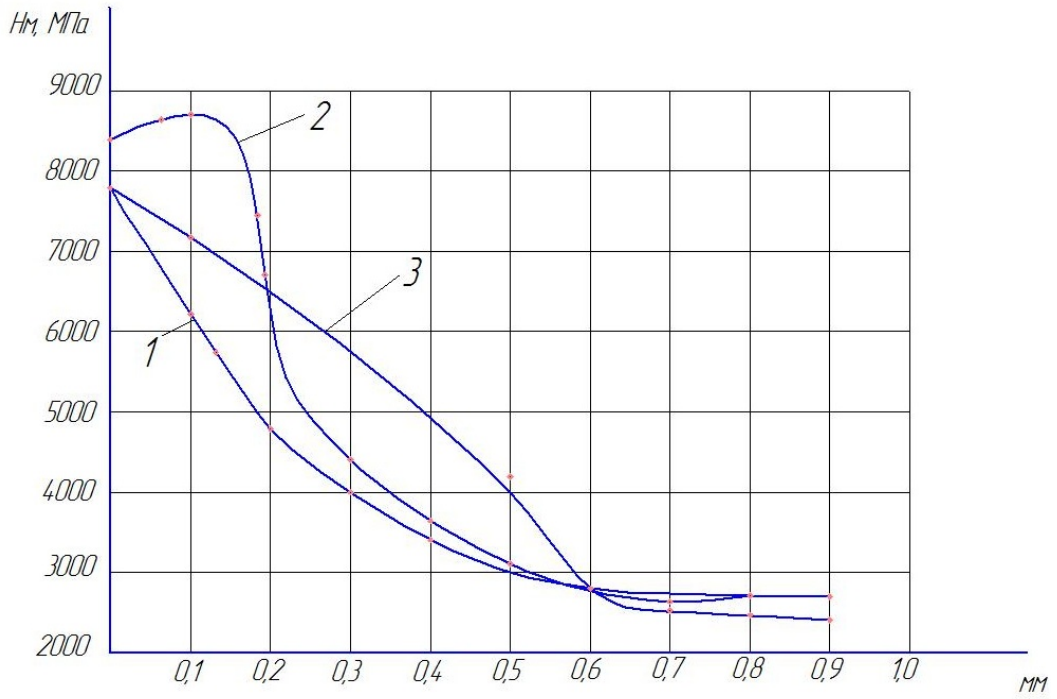

Fig. 1. Microhardness section of pump plungers Re SMD-60; 1 - new plunger; 2 - worn plunger; 3 - plunger nitriding restored to factory settings mode.

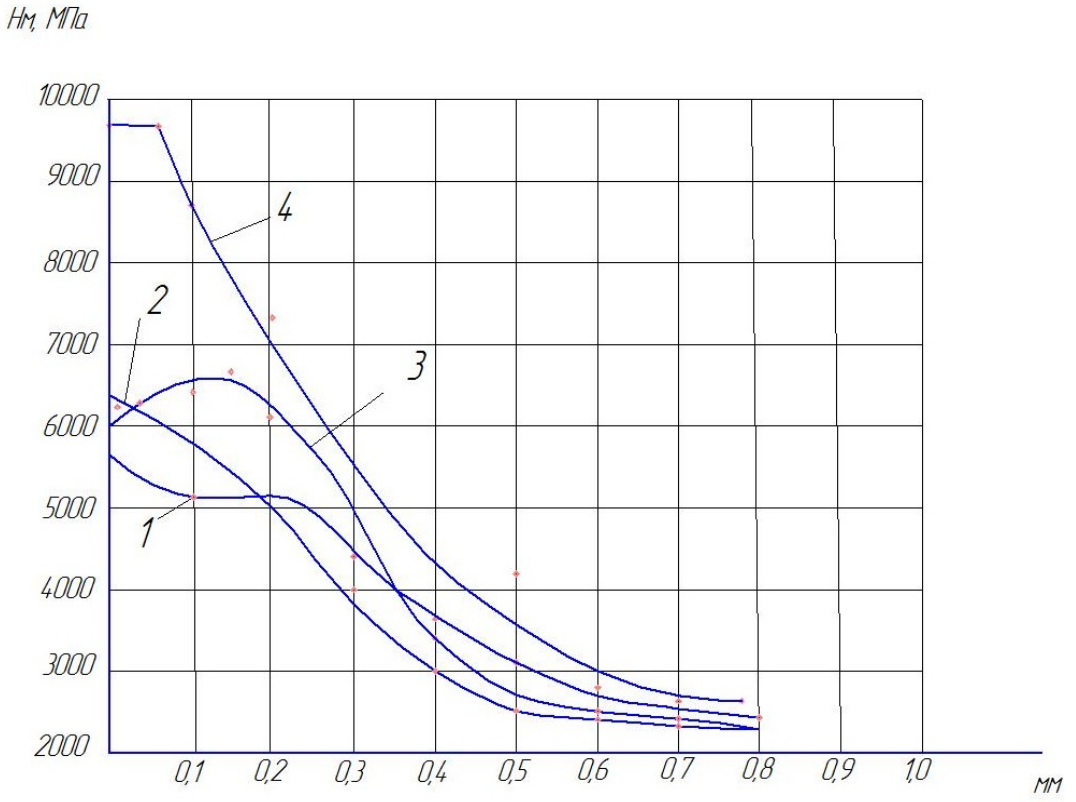

Fig. 2. Microhardness in section plungers restored: 1 - nitriding at 590 ...610^{at}WITH; 2 - karbonitruvannyam; 3 - oksynitruvannyam; 4 - rotary chrome.

Found that the new microhardness (Fig. 1, curve 1) and reduced (Fig. 1, curve 3) plungers to a depth of 0.1 mm is 7200 ... 7930 MPa. This depth of the nitrided (consolidated) amounted layer. 0.2 ... 0.3 mm for new and worn plungers. Worn plungers have even more to 8350 ... 8590 MPa Microhardness. The thickness of the hardened layer restored to factory settings mode plunger (Fig. 1, curve 3) reached to 0.35 ... 0.45 mm at most (4710 ... 6370 MPa) micro hardness at this depth.

Investigation of the microstructure of new, worn-out and refurbished by factory mode showed plungers reinforced layers have a structure of nitrogen sorbitol and sorbitol core, do not differ.

As shown studies restore worn plungers nitriding at a temperature of 590 ...610^{at}C, 7 h (Fig. 2, curve 1) provides a slightly lower microhardness 5210 ... 5720 MPa at a depth of 0.15 mm, a somewhat greater depth of the nitrided layer 0,35 ... 0,4 mm.

Karbonitruvannya gives higher 5350 ... 6110 MPa (Fig. 2, curve 2) microhardness of the surface layer to a depth of 0.15 mm for the nitriding temperature than 590 ...610^{at}C (Fig. 2, curve 1) at a depth of hardened layer 0,2 ... 0,3 mm.

Oksikarbonitruvannya (Fig. 2, curve 3) provides even higher than the surface layer microhardness karbonitruvannya that at a depth of 0.1 ... 0.2 mm is 6370 ... 6770 MPa at the depth of hardened layer 0,25 ... 0,35 mm.

The greatest microhardness 9560 ... 10150 MPa surface layer provides rotary plunger plating (Fig. 2, curve 4). The thickness of chromium up to 50 microns. Much higher microhardness 7180 ... 8380 MPa surface layer to a depth of 0.2 mm compared with other methods of recovery. In addition the total thickness of the hardened layer more and reaches 0,3 ... 0,4 mm.

The microstructure of core recovered plungers these methods were not significantly different compared to nitriding for factory mode.

Conclusions

The results of the research methods of restoring efficiency details plunger fuel pumps Re SMD-60 the following conclusions.

1. Details plunger fuel pumps can not restore nitriding for factory mode, for a change (increase) the diameter of the working surfaces is: for plungers 12 ... 19 m, hull 11 ... 21 mm, feeder 8 ... 12 microns, which is inadequate because the maximum wear is for plunger - 10 microns, the case - 14 microns, 5 microns dispenser and necessary grinding and grinding of parts.

2. Nitriding at a temperature of 500 ...520^{at}C and duration of 26, 52 and 78 h provides increased plunger diameter 3 ... 18 mm, reducing the diameter of the hole in the hull 9 ... 24 microns and dosing for 5 ... 18 microns, which is not enough to recover these details.

3. Cyanidation plungers duration of 5.8 and 10 hours gives increase its diameter only 9 ... 12 mm, which is not enough for recovery.

4. Details plunger can restore nitriding at a temperature of 590 ...610^{at}C. for 5 hours, oksikarbonitruvannyam, karbonitruvannyam and rotary chrome.

5. Nitriding at a temperature of 590... 610^{at}C, 5 h, oksykarbonitruvannya and increase the size karbonitruvannya provide remanufactured parts, Plunger for, respectively, 20 ... 45 microns, 18 microns and 30 ... 37 ... 38 microns; case for, respectively, 26 ... 37 microns; 51 ... 54 ... 40 microns and 53 microns; for dosing, respectively, 18 ... 45 microns; 13 ... 16 ... 15 microns and 18 microns, which significantly exceeds the maximum wear of these parts.

6. Excess increase the size of the working surfaces of plunger wear over them is:

– after nitriding at a temperature of 590 ...610^{at}C. for 5 hours plunger 10 ... 35 microns; case - 12 ... 23 microns and dispenser 13 ... 30 microns;

– after oksykarbonitruvannya: for plungers 8 ... 20 mm, case 37 ... 40 mm, dispenser 13 ... 30 microns;

– after karbonitruvannya: plunger for 27 ... 28 mm, case 26 ... 29 mm, 13-30 mm feeder;

– After plating rotary plunger 38 ... 40 microns.

7. Microhardness surface of the parts is restored after:

– nitriding plunger for factory mode the same as for the new - 7930 MPa;

– nitriding and case plunger at a temperature of 590 ...610^{at}C 5 hours significantly smaller - 5530 ... 5720 MPa;

– oksykarbonitruvannya - 6770 ... 7180 MPa, and karbonitruvannya - 6110 ... 8240 MPa;

– chrome rotary plunger - 9560 MPa.

8. The thickness of the hardened layer was recovered following details:

– nitriding for factory mode 0.35 ... 0.45 mm and microhardness 4710 ... 6370 MPa;

– nitriding at a temperature of 590 ... 610 ° C - 0.35 ... 0.4 mm and microhardness 5210 ... 5720 MPa;

– karbonitruvannya 0.2 ... 0.3 mm at 5350 micro hardness ... 6110 MPa;

– oksikarbonitruvannya - 0.25 ... 0.35 mm and microhardness 6370 ... 6670 MPa;

– rotary plating 50 microns in micro hardness layer 9560 ... 10150 MPa.

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Pryvedeny results of the study of properties and Changed razmerov details plunzhernыh toplyvnыh vapor recovery pump after nitriding, oksykarbonytryrovanyem, karbonytryrovanyem and rotary hromyrovanyem.

Plunzhernые rarы, Restoration, Methods, properties.

Results of research of properties and change of sizes of details of plunger pairs of fuel pumps after restoration are given by nitriding, an oxided carbon nitridation, carbon nitridation and chromium of rotor plating.

Plunger couples, restoration, ways, properties.