ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 4 , April 2020

Bases of Increasing the Resource of Wire Details in Accordance With the Inter-Repair Resource of the Machine

Kosimov K Z

Assistant Professor, Department of Technological machines and equipment, Andijan machine-building institute, Andijan, Uzbekistan

ABSTRACT: The possibility of a multiple increase in the resource of parts of a friction pair with the overhaul life of the machine is substantiated. The coatings obtained by contact welding of powder composite materials formed by composite materials from hard alloys are studied

KEY WORDS: friction pairs, resource of parts, overhaul life, wear, wear resistance, contact welding, powder composite materials, hard alloys.

I.INTRODUCTION

Today, the world economy uses numerous machines: cars, tractors, combines, machine tools, mechanisms, agricultural, reclamation and mining machines. As a result of ongoing research and development work to improve the machines year after year, the quality is increasing, the power and reliability of the machines being manufactured are increasing. At the same time, machine manufacturers are working on the problem of ensuring an equal resource of parts, components and assemblies with the resource of the machine. Despite these efforts, during operation, the machines fail due to premature failure of parts and assemblies. To prevent these failures, a system of technical maintenance and repair of machines has been introduced. These failures appear due to the difference in reliability, strength and resource of all the parts that make up the machine, high dustiness of the air, direct contact of the parts with the soil, and the difficulty of timely and high-quality maintenance.

Due to the insecurity of equal strength or equal wear resistance of parts, not a single product, especially a complex machine, can do without repair and maintenance, which are integral parts of the operation of the machine. [4]

II. LITERATURE SURVEY

The main reason for the need for machine repair is the wear of parts. As a result of wear of parts, the power and productivity of the machine decreases, the consumption of fuels and lubricants increases. Upon reaching a certain value of these indicators, for their recovery, the machine is subjected to repair. The main part of repair costs is the cost of spare parts. The main means of reducing the cost of spare parts in the repair of machines is the restoration of worn parts. Therefore, in the world, year after year, the volume of restoration of worn parts of machines is increasing. The highest development in the field of restoration of worn machine parts is observed in the USA, England, Germany, Italy, Japan, Austria, Hungary, Sweden, Sweden, Russia. As a result, during the repair of machines, the share of reconditioned parts in the consumption of spare parts amounted to 40% in Japan, and 30-35% in the USA, England, Germany and Austria. [2]

III. METHODOLOGY

The results of the analysis of the work of national and foreign scientists in the field of studying the causes of wear of parts working under friction and the development of recovery methods showed that the resources of the restored parts is about 0.8 ... 1.0 in relation to new parts [3,7,8] . But the work carried out to increase the resource of parts higher than 1.0 than new due to problems in the development of promising restoration technologies, technological equipment, methods, the choice of the composition of surfacing materials and the unreasonableness of the restored parts in relation

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 4 , April 2020

to the overhaul life of the machine did not find wide application in production. The scientific and practical problems associated with an increase in the wear resistance of the restored parts have not been adequately studied, an increase in their resource in accordance with the overhaul life of the machine, and therefore research conducted in this direction is relevant. The aim of our research is to develop the scientific basis for increasing the resource of worn parts in accordance with the overhaul life of the machine using methods of surfacing of powder composite materials.

It is known that it is impossible to get rid of the wear of machine parts, you can only protect yourself from its effects using seals and, more efficiently, using materials with high hardness for rubbing joints. As a rule, such materials are fragile and unsuitable for the manufacture of dynamically loaded machine parts. The solution to this problem is the application of wear-resistant layers. To increase the wear resistance, it is most effective to use highly alloyed steels, hard alloys, ceramic materials, and powder composite materials [5,6].

Interest in composite materials is associated with: on the one hand, the limited raw materials for producing high-quality alloys; the other is a set of unique properties of these materials, allowing to solve a number of technical problems unattainable in the metal design of iron alloys, as well as the ability to control the properties of materials. Recently, composite materials are also used in the form of coatings, which is very important for hardening machine parts. The existing experience with the use of composite coatings has shown the promise of this area for increasing the service life of machine parts. A feature of these materials during friction is their heterogeneous structure, fundamentally changing the mechanism of abrasive wear [3,7]. The widespread introduction of technological processes for the surfacing of new generation materials is hampered by the lack of comprehensive research to justify their application, the design of heterogeneous coatings, and the development of advanced technologies for applying them to the surface of parts. The problem of managing the resource of the hardened part, taking into account the effectiveness of a multiple increase in wear resistance, has not been solved.

Pursuing the problem of increasing the resource during the restoration and hardening of worn parts of machines, we drew attention to two ideas put forward in scientific journals.

The first of them consists in increasing the service life of the most rapidly wearing machine parts to a level exceeding the entire service life of the machine, the second consists in the average service life of various parts of the same machine should be multiple of each other and the overhaul period of the machine. [1,3]

Of these, the second direction, in our opinion, is the most practical and cost-effective. However, to implement this idea there are no necessary theoretical and practical recommendations.

In our opinion, it is possible to solve the problems of providing the necessary resource of quickly wearing machine parts in a more efficient way, by increasing the resource of the hardened part by a multiple, in relation to the overhaul life of the machine [8].

If other properties of the parts, in addition to wear resistance, do not lead to the exhaustion of the service life, wear resistance reflects their resource. Therefore, in many cases, the concepts of wear resistance or resource of machine parts are equally used.

It is known that the process of wear of parts is studied dividing into three periods. The first of these is the running-in period, the second period of normal operation, the third period of intense (catastrophic) wear. The period of normal operation occurs evenly and for a long time. Therefore, it is believed that the second period of operation of parts can be graphically depicted in a straightforward manner. Based on this, to determine the resource of the part and the pairing of the friction pair in relation to the overhaul life of the machine, we consider the following scheme (Fig. 1).

ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 7, Issue 4 , April 2020

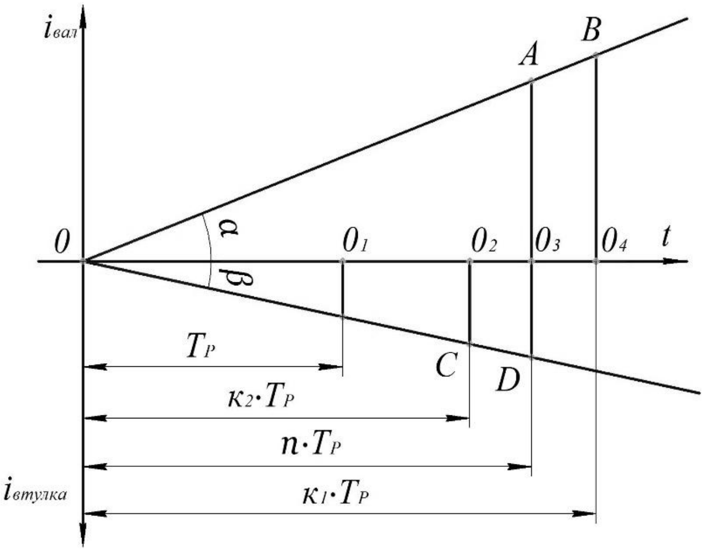


Fig. 1. Scheme for determining the wear rate of parts friction pairs.

It can be seen from triangle B0$_4$ that during the operation of part 004, the amount of wear will be equal to B0$_4$. Then the shaft wear rate is determined by the formula:

$$\varepsilon_{\text{вал}} = \frac{\mathrm{BO_4}}{\mathrm{OO_4}} = \frac{i_{\text{вал}}}{k_1 \cdot \mathrm{T_p}} \qquad (1)$$

Also from the triangle C0$_2$ you can determine the wear rate of the sleeve:

$$\varepsilon_{\text{втулка}} = \frac{CO_2}{\mathrm{OO_2}} = \frac{i_{\text{втулка}}}{k_2 \cdot \mathrm{T_p}} \qquad (2)$$

We draw up a scheme that allows us to determine how much the mating resource increases if the wear resistance of one part increases two, three or more times (Fig. 2).

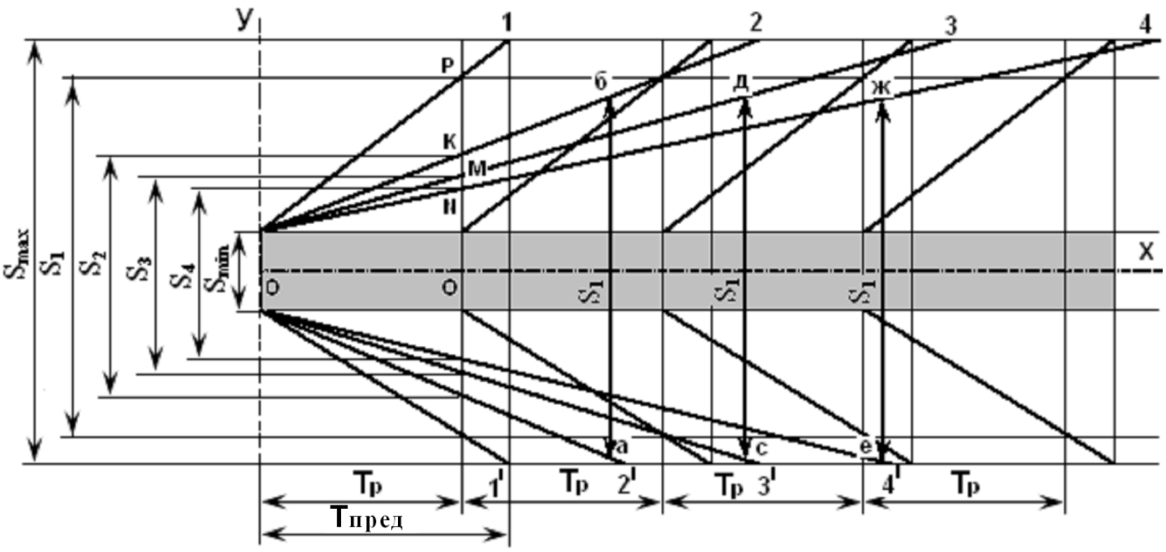


Fig. 1. The scheme for determining the mating resource, if the wear resistance of one part increases two, three or more times.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 4 , April 2020

If during repair a worn part is replaced by a new one, then after working out to the ultimate service life Tpred, the gap between the friction pair will increase from S_{min} to S_{max}. However, usually the gap does not reach the S_{max} value and the car is sent for the next repair. In this case, the gap will be equal to S_1 with the resource -Tr. Other parts with increased wear resistance (two, three, four, etc. times) are higher than the wear resistance of the new part after working through to the first overhaul life will have gaps S_2, S_3, S_4, etc. According to the established norms, the average value of the overhaul life of a machine will be equal to Tp ≈ 0.8 • Tpred. In this case, the wear values of the friction pair will be equal to the shaft and sleeve.
If, using surfacing, we apply a wear-resistant layer to the working surface of the shaft and thereby increase its resource by k_1, then the sleeve resource will increase by k_2, respectively. The data confirming the increase in the sleeve life in the friction pair with the hardened shaft were obtained by the corresponding experiments (Fig. 3).
Now we determine the pairing resource T_1 when the gap between the friction pair reaches the value S_1. To do this, using Fig. 1, we construct a diagram depicting the angle between the wear intensities of the friction pair. In this case, we exclude the initial gap S_{min} between their wear rates
Determine the total value of the wear pairing:

$$i_{conp} = S_1 - S_{min} = i_{вал} + i_{втулка} = k_1 \cdot T_p \cdot tg\alpha + k_2 \cdot T_p \cdot tg\beta = T_p(k_1 \cdot tg\alpha + k_2 \cdot tg\beta) \quad (3)$$

Determine the pairing resource when using a hardened part. To do this, we introduce a new coefficient of wear resistance of the interface n. Then the total value of the wear of the interface will be equal to:

$$i_{conp} = n \cdot T_p(tg\alpha + tg\beta) \quad (4)$$

From the expression 3 and 4 we get:

$$T_p(k_1 \cdot tg\alpha + k_2 \cdot tg\beta) = n \cdot T_p(tg\alpha + tg\beta) \quad (5)$$

From this equality we determine the coefficient n:

$$n = \frac{k_1 \cdot tg\alpha + k_2 \cdot tg\beta}{tg\alpha + tg\beta} \quad (6)$$

After transformations using expressions 3 and 4 we get:

$$n = \frac{k_1 \cdot k_2 (i_{вал} + i_{втулка})}{k_2 \cdot i_{вал} + k_1 \cdot i_{втулка}} \quad (7)$$

Consider some special cases.
1. If the wear rate of the shaft and the sleeve of the friction pair is taken equal to ival = i-bush, then the coefficient of wear of the interface will be equal to:

$$n = \frac{2 \cdot k_1 \cdot k_2}{k_1 + k_2} \quad (8)$$

Using expressions (8) and provided k1 = 2, k2 = 1.5, we determine the coefficient of the wear rate of the pair

$$n = \frac{2 \cdot 2 \cdot 1{,}5}{2 + 1{,}5} = 1\frac{5}{7}.$$

From this it follows that under these conditions, the pairing resource will be equal to:

$$T_1 = n \cdot T_p = 1{,}72 \cdot T_p$$

From the obtained result, we can conclude that with a two-fold increase in the wear resistance of the interface shaft, friction pairs are rejected during the first overhaul of the machine, since the life of this interface will be insufficient for the next overhaul period of the machine.
Now, consider the option when the wear resistance of the shaft is increased 3 times (k_1 = 3, k_2 = 2).

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 4 , April 2020

$$n = \frac{2 \cdot 3 \cdot 2}{3 + 2} = 2{,}4 \text{ , т.е.}$$

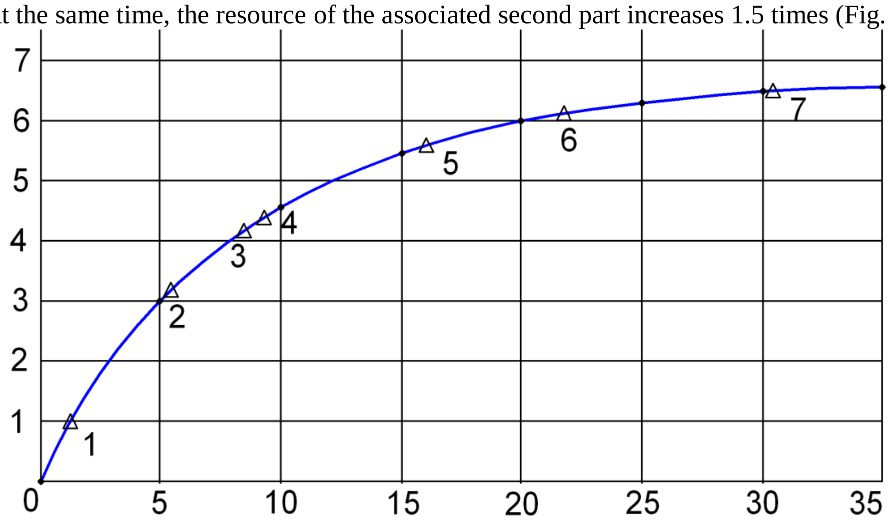
$$T_1 = n \cdot T_p = 2{,}4 \cdot T_p$$

You can also continue these calculations with the following values for increasing the wear resistance of friction pair parts.

An analysis of the results obtained on the basis of the above diagram (Fig. 1) showed that the shaft and the sleeve forming the friction pair mates are installed with an initial clearance S_{min}. If the machine fulfills T_{pred}, then the gap between the parts of the friction pair reaches up to S_{max}. But the machine does not work to this value is sent to the next repair with the time between T_r. In this case, the wear of the part reaches an acceptable value and the gap between the parts of the interface reaches up to S_1.

During overhaul, these parts are replaced with a new one and these parts gradually wear out until the next overhaul. In the second and third overhauls, this process is repeated.

If during overhaul, the first worn part is replaced by another, the wear resistance of which is doubled, the life of this part will double. At the same time, the resource of the associated second part increases 1.5 times (Fig. 3).



Wear resistance of hardened steel shaft (0-35) and wear resistance of a cast iron sleeve of a friction pair (1-7).

1-Art. 45; 2-solid alloy LPG; 3-composite material (30% PG-FH-800); 4- composite material (50% PG-FBH-6-2); 5-hard alloy VSNGN; 6-hard alloy T15K6; 7- hard alloy VK3.

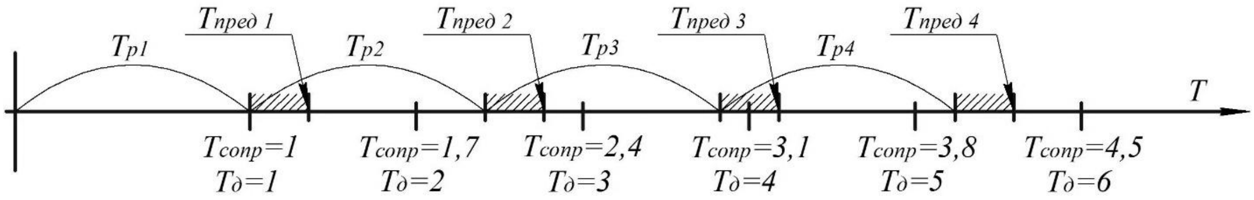
Fig. 3. The dependence of the wear resistance of the hardened shaft and the cast-iron sleeve in a pair of friction.

From fig. 2 it can be seen that these parts with two and one and a half times increased life work up to the permissible gap S1. Due to the insufficiency of these resources before the second overhaul, these parts are rejected during the first overhaul.

Also, if during overhaul, the first part will replace 3 and 4 with three and four times increased wear resistance, then the resources of these parts will increase 3 and 4 times. Then the resources of the parts associated with them increase, respectively, 2 and 2.5 times. In accordance with the above scheme, the gaps between these parts are reached to an acceptable value at points c and d, as well as e and g. From this it can be seen that the resource of interfacing with parts of three times increased wear resistance lasts up to the second overhaul life of the machine, and the resource of pairing with parts of four times increased wear resistance lasts up to the third overhaul life.

From the above it can be concluded that increasing the wear resistance of parts up to 2.5 times, it is impossible to use the pairing of this part of two or more overhaul life of the machine.

The results of these calculations show that for each particular case it is possible to obtain a multiple value of the coefficient of wear resistance corresponding to a natural number. To get a better understanding, these obtained values can be arranged along the time axes (Fig. 4).



T_p- overhaul resources
$T_{пред}$- marginal resources
$T_{сопр}$- pairing resources
$T_д$- parts resources (wear resistance)

Fig. 4. A diagram of the relationship between the resource of the hardened part - the pairing resource - the overhaul resource of the machine.

For our example, an increase in the wear resistance of one part of a friction pair from 1 to 2.5 times does not provide a twofold (overhaul life of the machine) increase in the mating resource. For some methods of hardening worn machine parts, such a 1.5-fold difference between the maximum and minimum values of wear resistance is an impressive indicator. Because the achievement of the upper value is accompanied by an increase in material, energy and other expenses. However, parts having a wear resistance index of 1 to 2.5 times due to insufficient resources until the second overhaul life of the machine are rejected.

IV. EXPERIMENTAL RESULTS

From the example it follows that for the hardened part of each type of friction pair, it is necessary to introduce a coefficient of wear resistance, providing a specific value of the mating resource corresponding to the overhaul life of the machine. These values should be close to the overhaul life of the machine on the large side. This achieves the maximum use of the wear resistance indicator with minimum hardening costs. In addition, if we take into account the conditions under which the overhaul life of the machine must be at least 80% of the resource to the limit state, then the resource (wear resistance) of the part should be provided from T_p to T_{pred}. For our example, according to the diagram in Fig. 4, the appropriate values of the wear resistance of the part correspond to from 1.0 to 1.25; from 2.5 to 2.75; from 4.0 to 4.25; from 5.5 to 5.75, etc.

This creates the ability to manage the resource of the mating parts in accordance with the overhaul life of the machine. All of the above-mentioned ones serve as a resource management technique for the mating parts in accordance with the overhaul life of the machine.

To determine the wear resistance of a shaft with an increased resource and a cast-iron sleeve of a friction pair, samples were prepared according to established methods and laboratory wear tests were carried out.

In fig. Figures 5 and 6 show graphs of the wear curves of the shaft and sleeve of a friction pair based on the results of wear tests. Based on these results, the wear resistance curve in Fig. 3.

The results showed (see table) that the wear resistance of some parts coated with composite carbide material is 20-30 times higher than hardened steel (Fig. 5). The wear rate of the second part associated with it is also given (Fig. 6). Based on the test results, the most suitable materials for the friction pair were selected.

Friction, Mx10^3 and wear, mm.

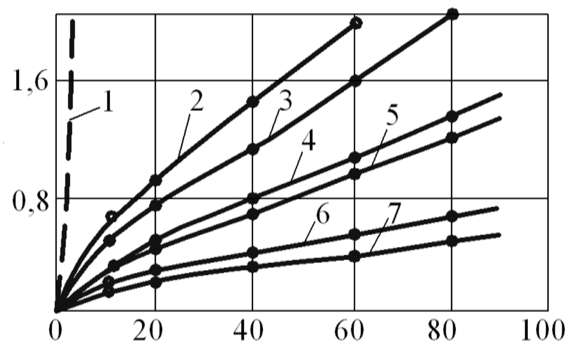


Fig. 13. Wear rates of hard alloys and steel

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 4 , April 2020

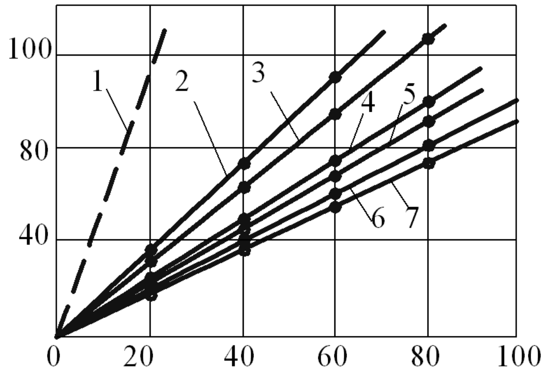


Fig. 14. The wear rate of cast iron by friction on carbide and steel

1 - steel St. 45; 2 - experimental material (30% ФХ – 800) 3 - experimental material (50% ФБХ-6-2) 4 - VK8 alloy; 5 - alloy T5K10; 6 - alloy T15K6; 7 - VK3 alloy.

The heterogeneous structures of the deposited coatings of the selected composition of sintered composite filler materials are substantiated. It should be noted that the hardness and particle size of the hardening phase of the composite coating should be higher than the hardness and particle size of the abrasive, and their content in the coating composition is set depending on the operating conditions of the part.

V. CONCLUSION AND FUTURE WORK

The results showed that the wear resistance of the deposited layer, with an increase in the amount of solid particles up to 50% in the composition of the powder composite material, increases. The use of hard alloys of titanium and tungsten instead of a hard chromium alloy also showed an increasing tendency to wear resistance.

In addition, due to the many types of solid powder alloys, different in wear resistance and materials, there is a wide possibility of changing the composition of the deposited coating, thereby achieving the required wear resistance of the part along the curve in Fig. 3.

Table 1

Average wear of samples

№ п/п	Deposited material	Surfacing method	Wear, mg/hour
1	Hard alloy LPG	Plasma surfacing	13,0
2	Hard alloy VSNGN	Plasma surfacing	4,5
3	Hard alloy T15K6	Contact welding	3,3
4	Hard alloy VK3	Contact welding	2,3
5	Sintered powder material (30% ФХ – 800)	Contact welding	8,5
6	Sintered powder material (50% FBH-6-2)	Contact welding	7,8
7	Reference sample Art. 45	Tempered HF to 55HRC	72,0

REFERENCES

1. Garkunov D.N. Tribotechnology (design, manufacture and operation of machines): Textbook. - 5th ed. Re-worker. and additional - Moscow: Publishing House of the Moscow Artists Academy, 2002.- 632 p.
2. Lyalyakin V.P., Ivanov V.P. Restoration and hardening of machine parts in the agro-industrial complex of Russia and Belarus // Repair, restoration, modernization. 2004. - No. 2. - 2s.
3. Polyachenko A.V. "The increase in the durability of the restored parts by contact welding of wear-resistant coatings in the conditions of agricultural repair enterprises." - Dis. Doctor of Technical Sciences Moscow, 1984.- 467 p.
4. Selivanov A.I., Artemyev Yu.N. Theoretical foundations of the repair and reliability of agricultural machinery. Moscow. Ear. 1978.- 247 p.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 4 , April 2020

AUTHOR'S BIOGRAPHY

Mr. Kosimov Karimjon

Academic qualifications:
1974-1979 student of Andijan agricultural institute, Andijan
1985-1988 PhD student of All-Russian Research Technological Institute of Repair and Maintenance of the Machine and Tractor Park of the Russian Agricultural Academy, Moscow
Work experience:
1988-1990 Assistant teacher of Andijan agricultural institute, Andijan
1990-1993 Senior teacher of Andijan agricultural institute, Andijan
1993-1998 Senior teacher, head of the chair of Andijan agricultural institute, Andijan
1998-2004 Dean of the faculty of Andijan agricultural institute, Andijan
2004-2018 Docent of Andijan agricultural institute, Andijan
2018-to now Docent of Andijan machine building institute