ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
Vol. 6, Issue 3, March 2019

# Research Wear Resistance Teeth of Gears at Rolling

**Ishmuratov H.K., Irgashev A.**

Senior teacher, department technique of rendering services, Tashkent State Technical University 100095, University str., 2, Tashkent, Uzbekistan;
Professor, department technique of rendering services, Tashkent State Technical University 100095, University str., 2, Tashkent, Uzbekistan.

**ABSTRACT**: The article discusses the wear resistance of gear teeth when rolling. In the rolling zone of the gear teeth, the wear process, as noted above, proceeds as a result of the deformation of the local metal volumes of the friction surfaces. When between the friction surfaces of the gear teeth, there is no slippage from the introduction of roughness projections in their contact zone, crater-shaped holes are formed, and wear products are formed after a certain amount of repeated deformations, the friction surface of the gears teeth are rounded roughness projections.

**KEY WORDS**: Gear teeth, Wear resistance, Rolling, Gear transmission.

## I.INTRODUCTION

Modern trends in the development of mechanical engineering lead to an even greater tightening of requirements for the quality parameters of gears during their design due to an increase in volumetric and contact stresses with a significant unevenness in their distribution, an increase in sliding speeds and temperatures due to an increase in machine productivity, an increase in the probability of failures due to complicated structures economic losses during the elimination of failures (loss of profit), expansion of the field of operation of machines - aggressive open environments, vacuum, vibration, various types of radiation, which require new approaches to the assessment of working capacity and new criteria of limiting states. Improving the durability of drive machines is one of the most important (along with increased productivity and cost reduction) requirements for designing machines, which is largely achieved by increasing the life of the main parts of the drive and, first of all, by increasing the wear resistance of their contact surfaces.

Accordingly, wear is a process of gradual change in body size during friction, manifested in the separation from the friction surface of the material and (or) its residual deformation. In gears heavily loaded machines there is a friction rolling friction with slipping. In this case, the main type of wear is abrasive-fatigue mechanical wear, and in the event of seizure occurrence - molecular-mechanical. Abrasive-fatigue mechanical wear (further wear) leads to a gradual change in the shape and size of the rubbing bodies. Despite the clarity of such common concepts as friction, wear and wear resistance, the determination of the numerical values of these values for specific operating conditions presents considerable difficulties. This is due to the complexity of the physical, chemical and mechanical phenomena that occur in the zone of contact of bodies, and the huge number of mutually influencing factors that determine the final result of wear.

However, the results of experiments conducted by V.V. Alisin [1] showed a large scatter of wear intensity values 5,1 10-10 ... 3000 10-10 for hardened wheels, and the wear rate of the driven wheels is an order of magnitude greater than the wear rate of the driving wheels. As a criterion of wear, it was also proposed to use the specific power expended on overcoming friction of contact surfaces [2-3]. The dependence of volumetric wear on the work of friction forces was also used by Fleisher [4-5] in the development of the energy theory of wear. The provision on the proportionality of the amount of wear to the work of friction forces for the calculation of the wear of machines was also applied by other researchers. A special place in the problem of wear resistance of gears belongs to jamming - that is, the process of the emergence and development of damage to the friction surface due to the setting and transfer of the material.

ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
Vol. 6, Issue 3, March 2019

## II. EXPRESSION FOR THE GRAIN SENSOR CAPACITY

In the rolling zone of the gear teeth, the wear process, as noted above, proceeds as a result of the deformation of the local metal volumes of the friction surfaces. When between the friction surfaces of the gear teeth, there is no slippage from the introduction of roughness projections in their contact zone, crater-shaped holes are formed, and wear products are formed after a certain amount of repeated deformations, the friction surface of the gears teeth are rounded roughness projections. The speed of wear of the teeth of the gears in the zone of contact of the initial circles, when rolling in general, is determined by the expression:

$$\gamma_{\partial(w,k)} = \frac{v_{1н(w,k)} \cdot M_{ob} \cdot n_{w,k} \cdot \eta}{F_{nk} \cdot n_{p(w,k)}}, \ m/h, \quad (1)$$

Where $M_{to}$ - is the total number of roughness protrusions located on the contact area of the gear teeth.

To calculate the deformed metal volume of the contact surfaces of the gear teeth with a single ridge of roughness, having a spherical shape, taking into account the diameter of the contact patch aw, K and the hardness of the gear $H_{w,K}$, when the protrusions of the roughness of the tooth surface have a rounded shape, when the initial circles of the contact teeth are rolling Gears obtained dependence [6]:

$$v_{1H(wk)} = 5{,}75 \cdot \frac{\theta^2_{sh,k} \cdot k^3 \cdot m^3 \cdot \sigma^3_{izg}}{9 \cdot c \cdot H_{sh,k}}, \ \text{m}^3. \quad (2)$$

In the zone of contact of the initial circles of gearing gears - the value of the gear tooth height ratio in the area of the initial circle k can be represented by the ratio of the contact width of the teeth to the gearing module,

$$k = \frac{B}{m},$$

then expression (2) has the form,

$$v_{1H(wk)} = 0{,}639 \cdot \frac{\theta^2_{sh,к} \cdot B^3 \cdot \sigma^3_{izg}}{c \cdot H_{shк}}$$

The contact area of the friction surfaces of the rolling zone of the teeth of gears is equal to:

$$F_{nк} = L \cdot B, \ m^2 \quad (3)$$

The amount of deformation of the friction $M_b$ surfaces depends on the number of roughness protrusions; for calculating the number of roughness projections located across the contact width of the gear teeth, the dependence is obtained:

$$M_b = \frac{1{,}69 \cdot \sqrt{\rho_{sh,k}} \cdot (1-\mu^2) \cdot c \cdot H_{sh,k}}{\sqrt{E \cdot B \cdot \sigma_{iz}}} \quad (4)$$

According to [6], in the zone of contact of the initial circles of gear gears, only rolling occurs, without slipping the teeth. For this case, the radius of curvature of the tooth profile of the pinion gear,

$$\rho_{sh} = 0{,}5 \cdot m \cdot z_{sh} \cdot \sin\alpha, \ \text{m};$$

the radius of curvature of the tooth profile of the driven gear,

$$\rho_k = 0{,}5 \cdot m \cdot z_{sh} \cdot i \cdot \sin\alpha, \ \text{m}.$$

The total number of roughness protrusions located on the contact area of the teeth, taking into account expressions (4), is equal to:

ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
Vol. 6, Issue 3, March 2019

$$M_{ob} = M_b \cdot M = \frac{0{,}34 \cdot \sqrt{\rho_{sh,\kappa}} \cdot (1-\mu^2) \cdot \theta \cdot L \cdot c^2 \cdot H^3_{sh,\kappa}}{\sqrt{E \cdot (B \cdot \sigma_{iz})^3}} \quad (5)$$

The calculated value of the probability of re-deformation $\eta_{ш,\kappa}$, the outgrowth of the roughness of the same deformed surface is determined by the dependence [7]:

Substituting the values of η from the equation $n_{p(sh,\kappa)}$, $v_{1н(w,k)}$, $F_{п\kappa}$, $M_{ob(sh,\kappa)}$, finally get:

$$\gamma_{\partial(w,k)} = \frac{5950 \cdot \theta^2_{sh,k} \cdot B^{5/2} \cdot \sigma^{5/2}_{iz} \cdot n_{sh,k}}{i \cdot L^{1/2} \cdot \psi^t_{sh,k} \cdot P^{1/2}}, \text{ m/h.} \quad (6)$$

## III. EXPERIMENTAL RESULTS

The resulting expression shows that the speed of wear of the gear teeth in the zone of contact of the initial circles of gearing gears, the rolling zone depends on the length of the tooth, gear ratio of gear teeth and frictional fatigue of the material, the width of contact of gear teeth, bending stress arising from the leg.

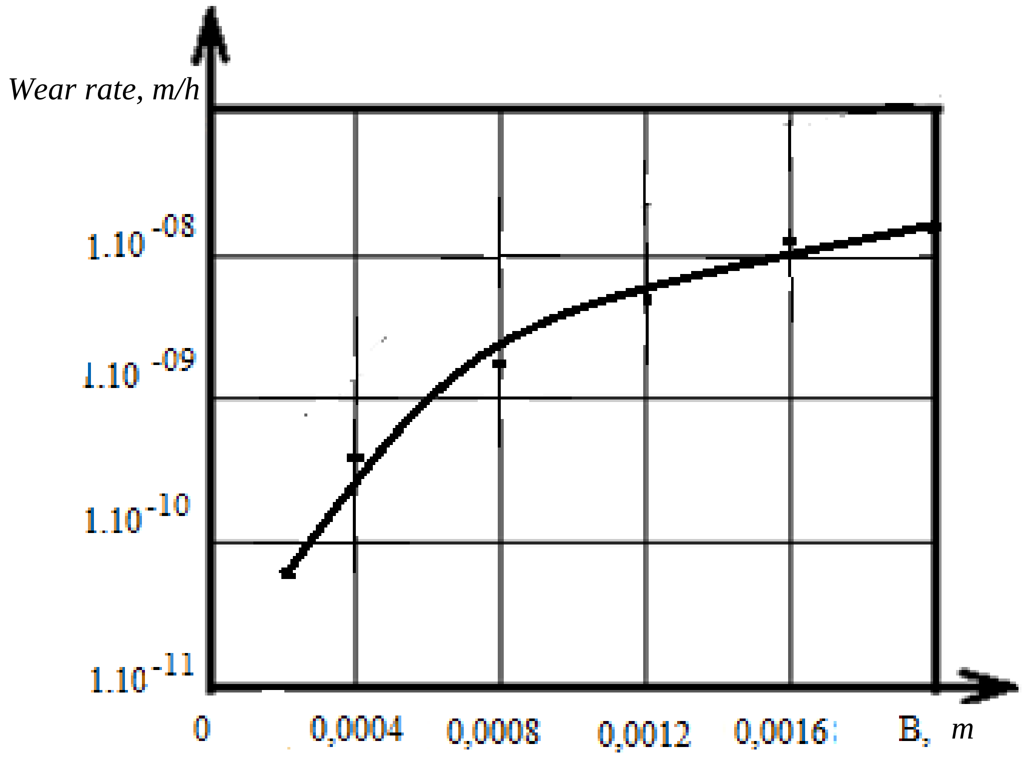


Fig.1. The Change in the Wear Rate of the Tooth of the Drive Gear Depending on the Width of the Contact Teeth of the Gears

The dependence of the change in the rate of wear of the rolling zone of the teeth of the pinion gear shown in Fig. 1 is derived from expression 20 with the following source data: $\theta$=4,23*10$^{-6}$ 1/MPa; $n_{sh}$=2,92 ob/s; $p$=0,14 MN; $i$=0,125; $L$=0,058 m; $\sigma_{iz}$=153,7 MPa; $\psi_{sh}$=6 %; $i$=2.

ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
Vol. 6, Issue 3, March 2019

## IV. CONCLUSION AND FUTURE WORK

With an increase in the contact width of up to 0,0008 m, the rate of wear of the teeth in the rolling zone of the initial circles of gears participating in the gearing grows more intensively, a further increase in the width of contact of the teeth to 0,0020 m leads to an increase in the rate of wear of the teeth less intensively.

A relationship has been established between the bending stress that occurs at the tooth stem and the hardness of the gear material; the most effective wear resistance of the gear teeth is when the ratio of hardness to bending stress that occurs at the tooth stem is 1,88 times.

## REFERENCES

[1]Kragelky I.V., Dobychin M.N. Kombalov V.S. Basics of calculations for friction and wear.M., “Mashnastoroenie”, 1977. - 526 p.
[2]Chudakov E.A. New gear calculation method. L., Publishing House of the Academy of Sciences.
[3]Ketov H.F., Kolchin N.I. Theory of mechanisms and machines.M., “Mashgiz”.
[4] Fleisher G. EnergetischeMetode der Bestimmung des Verschleibes. Schmierungstechnik, Bend 4, 1973. − s.9.
[5]Onishchenko V. Prediction of durability of heavily loaded gears based on the simulation of wear of teeth. PolytechnikaSlaska, Machanica, z.131, Gliwice, 1999 −199 p.
[6]Irgashev A. Methodological basis for improving the wear resistance of the gears of heavy duty gears of machine units. - The dissertation of the doctor of technical sciences. - Tashkent, 2005, 244 p.
[7]Irgashev B. A. Forecasting the Consumption of Spare Parts in Machines Based on the Content of Wear Particles in Oil Journal of Friction and Wear, Allerton Press. 2015, Vol. 36, No. 5, pp. 441–447.