ISSN: 2181-1067 Journal homepage: www.summusjournals.uz ISSN: 2181-1253

International scientific and technical journal
INNOVATION TECHNICAL AND TECHNOLOGY
Vol.2, №.1. 2021.

CALCULATION OF THE ENGAGEMENT MODULUS TO ENSURE WEAR RESISTANCE OF THE GEARING

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Abstract. During machine operation 34.2% of gears are one of the factors negatively affecting machine life due to abrasion, abrasion, scratching of friction surfaces, plastic deformation and destruction of teeth, as well as factors affecting machine performance and use due to abrasion, material fatigue, as well as factors affecting machine performance and use due to abrasion, material fatigue. The paper found that abrasion occurs on the abrasive surface, the intensity of abrasion by abrasive particles involved in the abrasion process depends on the degree of activity of the abrasive particles.

Key words: oil composition, consistent, gear teeth, tooth crown, oil, friction, parts.

Introduction

The toothed wheel is one of the most widely used parts in tractor driving. The materials used for gears are legalized steels with high mechanical properties and castings with high strength [1,2]. Tractor gears work under ORR conditions (high loads, shaft bending, abrasive environment). In this case, the following defects can occur: tooth penetration, places where the parts will be installed, mucking, dowel seating, slotted strips, as well as cracks and fractures in the teeth of the wheels where the fixing plug will be installed.

Gear teeth bite is mainly remedied by melting in a gas flame and electric arc, replacement of couplings and plastic deformation under pressure.

When repairing broken teeth with flame coating, materials corresponding to the gear material are used as a covering material. When melting and coating in electric arc tools, quality-coated electrodes are used. The teeth of gears working in an open and abrasive environment are usually coated with a plaster of refractory alloys [3]. Iron-chrome electrodes such as Sormite are used when chewing teeth are melted and coated and when the cemented layer is chewed with gum or crumbs [4].

Liquefaction work on gears with refractory alloys is carried out in the following sequence. The first layer is coated with liquid on the tooth and rolled hot and reinforced. The drive is then cleaned in razor blade equipment. The buna must be cleaned and reinforced with dissolved fly after each layer has been coated with liquid.

Materials and methods

It must be cooled down slowly to normal so that the liquid-coated wheel does not tilt. Liquid coated teeth are milled and polished to nominal size [5,6]. If the teeth of large modular gears break, they are repaired by laying them on parts, pins or additional parts which are twisted using screwing methods.

This method of repair should be used when the number of broken teeth does not exceed two grains when placed in a row. When repairing in this way, the broken part of the tooth is sawed off, the surfaces are cleaned, several holes are pierced and a spanner is inserted in them [7,8]. The circumference of the dowels is covered with plaster, leaving 3-5 mm of workable material, and the mechanical work is carried out to the nominal size.

When repairing threaded wheels, the method of replacing part of the part is also used. This method is mainly used when repairing a gearbox. The new pinion must also be made from the material of the cut out gearbox. In order to ensure that the combination is consistent, the new pinion is attached to the joint block with two or three screws or welded with an electric arc.

Cracks and fissures in the flanges and couplings are noticed and repaired by machining to nominal size. If threaded fitments are scored, they shall be brought to nominal size by fusion and plating, electrolytic coating and other methods.

The fusion and coating of the sides can be recommended when restoring the slope of the splines and dowel seats.

On repaired gears, the initial lap and lateral stroke must not exceed the limits of the specifications.

It should be noted that replacement of broken teeth is permitted as a temporary measure to dissolve and cover the new teeth and fit them. As a general rule, such gears should be replaced at the time of overhaul.

Results and discussing

Calculation of coupling modulus of last gear teeth from crushing of abrasive granules in oil in wedge gap has been done taking into account the friction of relative sliding of rolling, deformation of teeth surfaces of grit with deformation of adjacent surfaces. This condition arising on the teeth of the wheel corresponds to the conditions of non-abrasive friction of the abrasive particle in the dry aggregate oil, i.e. a closed gear of the station device in the clean oil.

Calculation of the gearing modulus after crushing abrasive particles in the oil in the wedge-shaped slot is made taking into account the surface tension of the gear teeth under relative sliding friction, as a result of deformation of the meshing surfaces of the wheel teeth [8].

This situation arising in the teeth of the wheels can be considered suitable for the conditions of friction of a closed gear unit in clean oil, that is, without abrasive particles contained in the aggregate oil curlma. It gives the following dependence for calculating the length of gear teeth and the ultimate linear wear of wheel teeth, the coupling modulus for the case, taking into account the deformation properties of the material of the gear:

$$m = \frac{0{,}0226 \cdot (1+i) \cdot z_{ш}^{2} \cdot \sigma_{тш} \cdot \sigma_{изг} \cdot \theta_{ш} \cdot U \cdot \psi_{m} \cdot \psi \cdot n_{ш} \cdot T}{c \cdot n_{рш} \cdot E_{пр}} \quad (1)$$

For cases where the air in which the open gear does not contain abrasive particles, there is a relative slippage between the teeth of the gear, the calculation of the clutch modulus was made by the following link:

$$m = \frac{3600 \cdot \pi \cdot (1+i) \cdot \sigma_{тш} \cdot \sigma_{изг}^{2} \cdot \theta_{ш} \cdot U \cdot \psi_{m} \cdot \psi \cdot n_{ш} \cdot T}{c \cdot z_{ш}^{2} \cdot n_{рш} \cdot E_{пр} \cdot H_{ш}} \quad (2)$$

To assess the cohesion modulus of a gearwheel operating in dry friction in an abrasive environment, we first determine the wear rate of the wheel tooth surface in the presence of abrasive particles. This requires determining the magnitude of the factors affecting the wearing rate.

Determine the volume of abrasive particles in contact with the wheel tooth profile during a single rotation of the drive pinion:

$$v_{\text{а}} = \frac{k_a \varepsilon_{в} v_{\text{в}}}{\gamma_a} = \frac{2k_a \varepsilon_{в} m d_{cp} z_{к} L}{\gamma_a} \quad (3)$$

where, k_a - value of coefficient, which takes into account contribution of that part of abrasive particles, which is in contact with friction surfaces and participates in wear process; γa - density of abrasive particles; $\varepsilon_{в}$ - amount of abrasive particles in the air, in which pinion works, its value depends on conditions of machine operation.

Depending on the location of the gearwheel in relation to the abrasive medium to be machined, the contribution of the abrasive particles involved in the separation and wear process to the friction surface adhesion k_a=0,25…0,55 varies at the boundary.

The amount of abrasive particles involved in the separation and wear process when the wheel tooth comes into contact with the friction surface:

$$n_v = \frac{v_a}{v_{1a}} = \frac{3{,}82 k_a \varepsilon_{в} m d_{cp} z_{к} L}{d_{\text{ср}}^3 \gamma_a}, \quad (4)$$

where, v_{1a} is the size of only one abrasive particle, which has a spherical shape.

For the case of relative sliding between the abrasive medium and the gear teeth in the meshing, the following analytical relationship is formed as a result of solving the formula for calculating the total wear [17] relative to the meshing modulus at the boundary of the components:

$$m = \frac{i \cdot \psi_m \cdot \psi \cdot n_{ш} \cdot T}{z_k \cdot n_{pш}} \left(\frac{3{,}6 \cdot \sigma_a{}^2 \cdot \sqrt{\varepsilon_k{}^3} \cdot \sqrt{\gamma_m} \cdot k_v \cdot d_{cp}}{H_{ш}^2 \cdot \Gamma_{ш} \cdot \sqrt{\gamma_a}} + \frac{3{,}14 \cdot (1+i) \cdot i \cdot \sigma_{mш} \cdot \sigma_{изг} \cdot \theta_{ш} \cdot U}{c \cdot z_k \cdot E_{np}} \right) \quad (5)$$

The results of the calculation of the relative sliding ratio of the pinion teeth are shown in Table 1, which shows the different K values for the skull of the tooth and the foot of the drive pinion.

k	0,000	0,167	0,333	0,500	0,667	0,833	1,000
$z_{ш}$	Relative sliding ratio of the gear teeth on the tooth crown						
11	0,000	0,873	1,645	2,331	2,967	3,559	4,115
15	0,000	0,908	1,706	2,439	3,125	3,759	4,367
19	0,000	0,920	1,748	2,513	3,236	3,906	4,566
23	0,000	0,929	1,776	2,571	3,311	4,016	4,695
27	0,000	0,936	1,795	2,611	3,378	4,115	4,808
31	0,000	0,940	1,812	2,639	3,425	4,184	4,902
$z_{ш}$	Relative sliding ratio of gear teeth for toothpaste						
11	0,000	0,849	1,565	2,169	2,695	3,165	3,597
15	0,000	0,889	1,642	2,309	2,907	3,448	3,937
19	0,000	0,905	1,692	2,404	2,865	3,636	4,184
23	0,000	0,917	1,730	2,469	3,155	3,788	4,386
27	0,000	0,923	1,757	2,525	3,236	3,891	4,525
31	0,000	0,927	1,776	2,564	3,300	3,984	4,651

Table 1.Change in gear ratio relative to k with respect to wheel tooth height, gear ratio with respect to relative sliding

The gearing modulus is determined by the ratio of the gear tooth length to the gearing ratio to the load mode.

Wheel tooth wear after crushing abrasive particles in the wedge-shaped slot in the meshing of the teeth results from the interaction of the friction surfaces between the teeth, as if there were no abrasive particles in the oil.

As the coefficient of friction between the gear teeth and the abrasive particles increases, the size of the abrasive particles entering the wedge-shaped gap in the gearing increases.

In accordance with the results of these studies, it was found that by increasing the bending stress between the gear teeth, the gearing modulus, the speed of the drive pinion increases by an average of 89.88% regardless of the speed of rotation.

Consolation

The gear retention modulus is determined from the ratio of the gear tooth length to the retention ratio to the loading mode.

After grinding abrasive particles in the wedge gap in the thread connection, the tooth eating of the wheel becomes sodden as a result of the grinding friction surfaces interacting with the teeth as if there were no abrasive particles in the oil composition.

References

1. Irgashev B.A., Irgashev A.I. Forecasting the consumption of spare parts in machines based on the content of wear particles in oil. Journal of Friction and Wear. 36(5), 2015. p. 441-447.
2. N.N.Mirzayev, B.B. Qurbonov, Hamroyev R. K. Estimation of the rotation speed of gears in oil depending on the load//“Technical science and innovation” Tashkent 2020, №4(06) 198-204 б.
3. Mirzayev Q.Q., Irgashev A. Wear resistance of rolling-ball bearings operating in an abrasive medium. Journal of Friction and Wear. Volume 35, Issue 5, 24 October 2014, Pages 439-442.
4. N.N.Mirzayev, Khamraev R. K. Determining the demand for grain transport during the harvest period**. *//*** “Technical science and innovation”. Tashkent 2020, -№2 (04). pp. 135-141
5. Wolf A.K. Improving the provision of the system of technical service of forest machines with spare parts: On the example of JSC "Kraslesmash": dis. Cand. tech. Sciences: 05.21.01 / A.K. Wolf. Moscow, 2006.- 125 p.
6. V.Y. Antonyuk, V.L. Basinyuk. « Gear. Normative and methodological support of gear accuracy at the design stage». Minsk 2016y. p. 245
7. Ikramov M.A., Sidiknazarov K.M., Ikramov A.A. Abdurakhmanov and others. Car service. T : Publishing house of the National Library of Uzbekistan named after A. Navoi, 2010 .-266 p.
8. Gorlenko OA, Makarov GN, Shnyrikov IO Increase of contact endurance of teeth of spur cylindrical gears // Friction and lubrication in machines and mechanisms. - 2014, No. 6, 25-27.