It should be noted that $t_{*\min}$ is higher under the triple-pair meshing, and the tooth correction also leads to an increase in the gear life. However, the change in the contact conditions (particularly $p_{jh\max}$) due to the wear of the gear teeth has practically no effect on the minimum gear life $t_{*\min}$ (the gear life does not decrease to any significant extent). This fact can be explained by the presence of two competitive processes when $p_{j\max}$ = var:

a) both the friction path of $2b_{jh}$ and the tribocontact time of $t'_{jh} = 2b_{jh} / v_j$ increase, which leads to an increase in the linear tooth wear h_{j2B} during their interaction in block B;

b) the contact pressures $p_{jh\max}$ decrease (Fig. 4) due to an increase in the reduced curvature radius.

An analysis of the results demonstrates that the pressure $p_{jh\max}$ has a more significant effect on the minimum gear life than t'_{jh}. Generally, the minimum gear life $t_{*\min}$ practically does not change, compared to the case when $p_{j\max}$ = const.

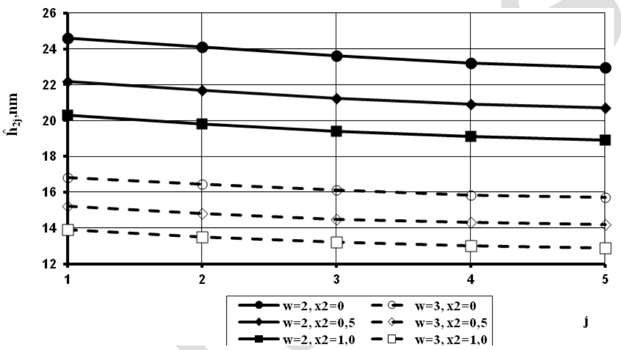

Fig. 6. Linear wear of the gear tooth profile per hour.

Figure 6 shows the variation in the linear tooth wear $\hat{h}_2$ per hour at individual meshing points when $p_{\max}$ = const. The results also demonstrate that at $p_{\max}$ = var, the wear $\hat{h}_2$ (in the last interaction block) is slightly higher.

4. CONCLUSIONS

1. The purpose of the publication on the study of the effectof parity of the gear in the worm gear, correction of the teeth and wear on their contact strength and resource has been fully accomplished.
2. The type of meshing has a significant effect on $p_{j\max}$, $p_{jh\max}$ and $t_{*\min}$. The maximum contact pressures $p_{j\max}$ decrease by almost 1.22 times, while the maximum tribocontact pressures $p_{jh\max}$ decrease by 1.2 times.
3. Following the worm gear tooth correction by $x_2 =$ 0...1.0, $p_{j\max}$ decreases by 1.28 times, whereas $p_{jh\max}$ decreases by 1.1 up to 1.21 times.
4. After changing the meshing type, the minimum gear life increases by 1.46 times, whereas after the change in x_2 – it only increases by 1.22 times.
5. The results confirm that when calculating the life of worm gears, one must consider the following factors: technological (gear tooth correction), meshing engagement (double- and triple-pair), operational (gear tooth wear), tribological (the coefficient of friction, wear resistance of gear materials).

REFERENCES

[1] K.J. Sharif, S. Kong, H.P. Evans, R.W. Snidle, *Contact and elastohydrodynamic analysis of worm gears: Part 1 Theoretical formulation*, Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, vol. 215, iss. 7, pp. 817-830, 2001, doi: 10.1243/0954406011524171

[2] K.J. Sharif, S. Kong, H.P. Evans, R.W. Snidle *Contact and elastohydrodynamic analysis of worm gears: Part 2 Results,* Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, vol. 215, iss. 7, pp. 831-846, 2001, doi:10.1243/0954406011524180

[3] K.J. Sharif, H.P. Evans, R.W. Snidle, D. Barnett, I.M. Egorov, *Effect of elasto-hydrodynamic film thickness on a wear model for worm gears*, Proceedings of the Institution of Mechanical Engineers, Part J: Journal of Engineering Tribology, vol. 220, iss. 3, pp. 295-306, 2006, doi: 10.1243/13506501JET122

[4] K.J. Sharif, H.P. Evans, R.W. Snidle, *Prediction of the wear pattern in worm gears*, Wear, vol. 261,

iss. 5-6, pp. 666–673, 2006, doi: 10.1016/j.wear.2006.01.018

[5] K.J Sharif, H.P. Evans, R.W. Snidle, *Wear modeling in worm gears,* IUTAM Symposium on Elastohydrodynamics and Micro-elastohydrodynamics, vol. 134, pp. 371-383, 2006, doi: 10.1007/1-4020-4533-6_27

[6] R.W. Snidle, H.P. Evans, *Some aspects of gear tribology*, Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, vol. 223, iss. 1, pp. 103-141, 2009.

[7] H.G. Sabiniak, *Wear and life of the worm gears,* Publishing House of Lodz University of Technology: Lodz, 2007. (in Polish)

[8] D. Jbily, M.Guingang, J.P. de Vaujany, *Loaded behaviour of steel / bronze worm gear*, in International Gear Conference, 26-28 August, 2014, Lyon Villenbanne, France, pp. 32-42, doi: 10.1533/9781782421955.32

[9] D. Jbily, M. Guingang, J.P. de Vaujany, *A wear model for worm gear,* Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, vol. 230, iss. 7-8, p.p. 1290-1302, 2016, doi: 10.1177/0954406215606747

[10] V.B. Al'gin, V.E. Starzhinskii, *Gears and Transmissions in Belarus: Engineering, Technologies and Properties,* Minsk: Belarusskaya Navuka, 2017. (in Russian)

[11] M.V. Chernets, R.Ja. Jarema, *Prediction of the life of the worm gears in Archimedes and involute worm gears*, Problems of Tribology, vol. 60, no. 2, p.p. 21-25, 2011.

[12] M. Czerniec, J. Kielbinski, J. Czerniec, *The effect of teeth correction in an Archimedes worm gear on the contact strength, wear, and life of the worm gear teeth,* Tribologia, no. 1, pp. 31-34, 2017.

[13] M.V. Chernets, *Prediction Method of Contact Pressures, Wear and Life of Worm Gears with Archimedean and Involute Worm, Taking Tooth Correction into Account,* Journal of Friction and Wear, vol. 40, no. 4, pp. 342-348, 2019, doi: 10.3103/S1068366619040032

[14] M. Chernets, *A method for predicting contact strength and life of Archimedes and involute worm gears, considering the effect of wear and teeth correction,* Tribology in Industry, vol. 41, no. 1, p.p. 134–141, 2019, doi: 10.24874/ti.2019.41.01.15

[15] M.V. Chernets , Ju.M. Chernets, *Evaluation of the strength, wear, and durability of a corrected cylindrical involute gearing, with due regard for the engagement conditions,* Journal of Friction and Wear, vol. 37, no. 1, p.p. 71-77, 2016, doi: 10.3103/S1068366616010050

[16] M. Chernets, *Method of calculation of tribotechnical characteristics of the metal-polymer gear, reinforced with glass fiber, taking into account the correction of tooth*, Eksploatacja i Niezawodnosc – Maintenance and Reliability, vol. 21, iss. 4, pp. 546–552, 2019, doi: 10.17531/ein.2019.4.2

NOMENCLATURE

a [mm] is the center distance in an uncorrected gear,

b_2 [mm] is the width of the worm gear,

C_k, m_k [-] are the indicators of wear resistance of the tribological pair materials under selected wear conditions,

d_1 [mm] is the reference diameter of the worm,

d_2 [mm] is the reference diameter of the worm gear,

e_{pA} [mm] is the distance of *j*-th point from the contact point,

f [-] is the coefficient of sliding friction,

q [-] is the diametric quotient of the worm gear,

$\hat{h}_{2jn}$ [mm] is the linear wear of the gear teeth during a single interaction, reduced due to changes in ρ_{2jh}, t'_{jh}, $p_{jh\max}$,

h_{2jB} [mm] is the wear of the gear teeth during a single cycle of interaction,

h_{2*} [mm] is the maximum wear of the worm gear teeth,

j [-] is the point of contact between the kinematic pair elements (worm – worm gear),

m [mm] is the axial modulus of meshing,

n_1 [rpm] is the number of revolutions of the worm,

n_2 [rpm] is the number of revolutions of the worm gear per minute,

n_{2*} [rot] is the number of revolutions of the worm gear when the maximum worm gear teeth wear h_{2*} is reached,

N' [N] is the meshing force,

N [kW] is the transmitted power,

$p_j = p_{j\max}$ [MPa] are the maximum contact pressures determined by the Hertz formula, depending on the number of meshing pairs *w* of the worm gear teeth,

$p_{jh\max}$ [MPa] are the maximum current tribocontact pressures,

r_{f1} [mm] is the radius of a circle of the worm cavity,

r_{a1} [mm] is the radius of a circle of the worm thread prongs,

t'_{jh} [sec] is the time of contact between the meshing elements at *j*-th point on the friction path with a length equal to the contact area width $2b_{jh}^{(w)}$,

t'_j [sec] is the time of contact between the meshing elements at *j*-th point on the friction path with a length equal to the contact area width $2b_j^{(w)}$,

T [Nmm] is the torque transmitted by the worm,

u [-] is the gear ratio,

v [mm/sec] is the sliding rate at *j*-th point of contact between the kinematic pair elements,

v'_j [mm/sec] is the sliding rate during worm gear revolution,

w [-] is the number of meshing pairs between the worm thread and the worm gear teeth,

x_2 [-] is the correction coefficient,

z_1 [-] is the number of worm threads,

z_2 [-] is the number of teeth on the worm gear,

α [degree] is the pressure angle,

α_{pxj} [degree] [14],

γ [degree] is the lead angle,

λ_h [-] is the non-dimensional coefficient of wear,

$\mu_k\,[-], E_k$ [MPa] are Poisson's ratio and Young's modulus of the worm gear material, respectively,

ρ_j [mm] is the reduced curvature radius between the worm coil and the gear tooth at *j*-th point of meshing,

ρ [mm] is the reduced radius of curvature of the involute worm gear,

ρ_{jh} [mm] is the reduced radius of curvature of the involute worm gear due to tooth wear; the wear of the steel worm is omitted,

ρ_{2jh} [mm] is the radius of curvature of the Archimedes worm gear,

ρ' [degree] is the friction angle,

τ_{s2} [MPa] is the temporary shear strength of the worm gear material,

θ [1/MPa] is the Kirchhoff modulus,

ω_1 [1/sec] is the angular velocity of the worm.