4. Sergeev S.T. Looking into causes of strength loss in running block wires. *Stalnye kanaty*. 1965. No. 2. pp. 417-420.

5. Kharitonov Vik. A., Kharitonov V.A. 5-12 mm cold-formed reinforcing steel of 500 strength grade: Current status and trends. *Stal*. 2008. No. 5. pp. 72-76.

6. Kharitonov Vik. A. Raising the competitiveness of cold-formed reinforcing steel by optimizing the relevant production process and equipment. *Ferrous Metallurgy. Chermetinformatsiya*. 2009. no. 6. pp. 15-22.

7. Kharitonov V.A., Radionova L.V. Properties of carbon wire created by cold forming: Monograph. Magnitogorsk: Publishing House of Nosov Magnitogorsk State Technical University, 2001. 127 p.

8. Kharitonov V.A., Petrov I.M. Coiled low-carbon reinforcing steel: Analysis and development of production processes. *Processing of solid and laminate materials*. 2012. No. 38. pp. 31–38.

9. Zaytseva M.V., Dryagun E.P. Development strategy for 500 grade reinforcing wire produced at MMK-METIZ. *Izvestiya TulGU. Tekhnicheskie nauki*. 2020. Iss. 8. pp. 232-240.

10. Zvezdov A.I., Snimshchikov S.V., Kharitonov V.A., Surikov I.N. Advanced reinforced concrete: Problems and development paths. *Beton i zhelezobeton*. 2015. No. 4. pp. 2-8.

11. Snimshchikov S.V., Kharitonov V.A., Surikov I.N., Savrasov I.P. A new standard on reinforcing steel. Today's challenges and development strategy. *Ferrous Metallurgy. Bulletin of Scientific, Technical and Economical Information*. 2017. No. 5 (1409). pp. 3-9.

12. Snimshchikov S.V., Kharitonov V.A., Savrasov I.P. Reality and expectations of today's rebar market. To mark the release of the new GOST 34028-2016. *Ferrous Metallurgy. Bulletin of Scientific, Technical and Economical Information*. 2017. No. 6 (1410). pp. 9-17.

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A WIRE FINE DRAWING PROCESS FOR MEGA-STRENGTH STEEL CORDS

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The studies are aimed at performing a temperature analysis of a drawing process of fine wire, 0.295MT mm in diameter, and developing a drawing sequence with minimum wire surface temperatures in fine drawing dies.

We developed the fine drawing process for wire 0.295MT from wire stock, 1.85 mm in diameter, steel 100, to reduce wire breakage during stranding of steel cords 2x0.295MT. The development factored into a reason for steel cord breakage during stranding, lying in overstrengthening of the wire surface during fine drawing as a result of dynamic deformation aging of wire steel, depending on wire temperature in drawing mill dies, among other factors.

The phenomenon of deformation aging of steel lies in the interaction between impurity atoms C, N, and H with dislocation centers. This interaction limits mobility of dislocations in grains of the steel structure, reducing ductility of steel. The phenomenon of deformation aging is limited by decreasing drawing temperature. Deformation temperature can be decreased only with a decrease in the rate and degree of deformation. Maximum deformation temperatures during drawing occur on the wire surface, where heating energy depends on energy generated from internal and contact friction. Therefore, it is required to reduce the loss of ductility of the wire surface layers, which receive maximum mechanical loads during steel cord stranding, causing the propagation of cracks in steel cord wire.

Following the adopted physical principle of designing a drawing sequence, we determined die diameters and analytically calculated wire surface temperature in the proposed drawing sequence (Fig.1) at a drawing speed of 8 m/s.

A further search for ways to decrease wire temperature by a numerical simulation of wire deformation in dies led to the following result: reducing the die bearing to 0.3 of the die diameter entailed a decrease in temperature by 25% in the first double die and by 25% in the second double die compared with the die, having length of the die bearing of 0.5 of the die diameter. Wire is colder by 18% between double dies with a shorter die bearing compared with the existing option, having a die bearing of 0.5 of the die diameter.

The analytical and numerical calculations of temperature values were proved with measuring surface temperature of wire, exiting the drawing mill.

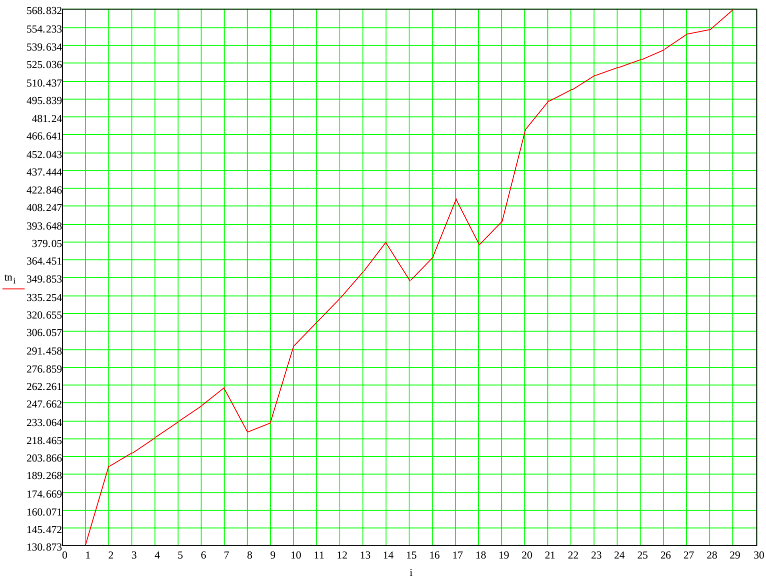

Fig.1 – Wire surface temperature change tn_i in °C depending on fine drawing die number i (29 dies, including double dies)

References

1. Bobarikin Yu.L., Vereshchagin M.N., Martyanov Yu.V. Fine drawing and stranding of steel brass-plated wire into steel cords. Gomel: Sukhoi State Technical University of Gomel, 2018. 304 p.

2. Bobarikin Yu.L., Avseikov S.V. Predicting and reducing breakage, when producing ultrahigh strength steel cords. XVII International Scientific Conference "New Technologies and Achievements in Metallurgy, Material Engineering and Production Engineering". Monograph No. 48 edited by H. Radomiak, J. Borica. Czestohowa. 2016. pp. 205-212.