UDC 629.771.01

A.N. Nikolaenko [1], professor, c.t.s.
Yu.P. Taran [2], engineer

THEORETICAL DETERMINATION OF PURVEYANCE DRAG AT PROCESS OF ROLLING IN PRODUCTION OF ALUMINIUM ROLLED WIRE

[1] Zaporozhe state engineering academy,
[2] PAJ «Zaporozhe plant of aluminium rolled wire»

The theoretical researches of the workpiece bland drag during the rolling at the production of aluminum rolled wire were performed. It is offered a formula which would be convenient for practical calculations of the workpiece bland speed on entrance to the mill and in order to improve the controlling algorithm by the work of casting-rolling unit.

Keywords: heath of deformation, angle of bite, drag and passing workpiece bland, casting-rolling unit

In the process of drafting of bands mill one part of metal is squeezed out in the direction of motion, creating the zone of passing, and other it part is expressing out in an opposite side, forming the zone of drag. In the theory of rolling basic attention is spared to research of passing which, both experimentally and analytically executing is simpler [1].

At the same time at perfection of management by work of the casting-rolling module of PAJ «Zaporozhe plant of aluminium rolled wire» considerable interest causes research of drag of metal in the hearth of deformation and influence of it on the process of forming of purveyance length of which must be supported in set values. The calculations of metal drag of with the use of existent experimental for-mula are related to some inconveniences and not executed practically, as this formula contains passing, calculated on speeds rollers and band on an exit from them, measuring of which commensurably with in size passing. In this connection interest presents receipt of equation, comfortable for application in practice at the calculation of purveyance speed on included in a mill for perfection of algorithm of management by work of the casting-rolling module.

At rolling of band on an area l, equal to length of hearth of deformation, under the action of mechanical effort of rollers there is deformation of band and through time t it vertical section takes form, near to the truncated cone. As far as the further moving a band is exposed to additional deformation. Through time $2t$, rolling turn on the double corner of capture and complete rolling of metal on an area long l. Here a band on an exit from rollers acquires large length due to a metal, squeezed out on a size $\Delta l_ð$ in the area of passing ($\Delta l_p = Ì_ð / F_o$, and also drag ($\Delta l_d = M - Ì_å / F_d$), where $M_ð$ is a volume of metal, squeezed out in the area of passing; M is a total volume, squeezed out from the area of band long $M = l \cdot (F_å - F_o)$; $F_å$, F_o are a section of band before rollers and on an exit from them accordingly.

At joint consideration of the indicated correlations relatively Δl_d it is possible to write down

$$\Delta l_d = \frac{l \cdot \Delta F - \Delta l_p \cdot F_o}{F_{\text{å}}} \ . \qquad (3)$$

Then resulting speeds of metal rolling on an entrance $V_{\text{å}}$ and output V_o of the first mill taking into account speed of rollers V_r it is possible to define with the use of equations:

$$V_{\text{å}} = V_r \cdot \cos\alpha - \frac{\Delta l}{2t} \ ; \qquad V_o = V_r + \frac{\Delta l_{\text{îï}}}{2t} \ , \qquad (4)$$

where $V_r \cdot \cos\alpha$ is an ichnography of speed of rollers in the section of included in a mill.

It is known [1], that the size of passing is calculated on a formula

$$S_{\text{ð}} = \frac{V_o - V_r}{V_r} \ . \qquad (5)$$

Then taking into account equations (4) and value of time t, determined, as $t = l/V_r$ a formula (5) can be written down

$$S_{\text{ð}} = \frac{\Delta l_{\text{ð}}}{2l} \ . \qquad (6)$$

In accordance with work [1] passing can be expected as

$$S_{\text{ð}} = \frac{l + \Delta l_{\text{ð}}}{R \cdot \left(\frac{\Delta h}{R} \right)^{0,5}} - 1 \ . \qquad (7)$$

Equate right parts of equations (6) and (7) and a parameter $\Delta l_{\text{îï}}$, taking into account that $l = R \cdot \sin\alpha$, is determined.

$$\Delta l_{\text{ð}} = \frac{2R \cdot \sin\alpha \cdot \left[\sin\alpha - \left(\frac{\Delta h}{R} \right)^{0,5} \right]}{\left(\frac{\Delta h}{R} \right)^{0,5} - 2\sin\alpha} \ . \qquad (8)$$

After the substitution of expression (6) or (7) taking into account correlation (8) in the known formula of drag [1] it is possible to write down

$$S_d = 1 - \frac{1 + S_p}{\lambda \cdot \cos\alpha} = 1 - \frac{F_o \cdot \mathrm{tg}\,\alpha}{F_{\text{å}} \cdot \left[2\sin\alpha - \left(\frac{\Delta h}{R} \right)^{0,5} \right]} \ , \qquad (9)$$

where λ is a coefficient of rolling-out.

By the feature of production of aluminium felled wire on PAJ «Zaporozhe plant of aluminium rolled wire» is rolling of purveyance in calibers, consequently, in the got formula of drag it is necessary to use the average value of corner of capture α_m and middle radius of roller R_m. In addition, a formula (9) must contain a coefficient k, taking into account the friction of contacting surfaces.

Then a theoretical formula for determination of drag of purveyance at the production of rolled wire assumes an air:

$$S_d = 1 - \frac{F_o \cdot \mathrm{tg}\,\alpha_m}{F_å \cdot \left[2\sin\alpha_m - \left(\frac{\Delta h}{R} \right)^{0,5} \right]} \cdot k \ , \tag{10}$$

It should be noted that at k = 1.03 in all checking calculations the error of calculation of drag goes down to 0.1-1.0 %.

For determination of speed of purveyance on included in the mill of the casting-rolling module it is possible to use a formula [1] $S_p = V_r \cdot \cos\alpha - V_b / V_r \cdot \cos\alpha$. Then get

$$V_å = V_r \cdot \frac{F_o}{F_å} \cdot \frac{\sin\alpha_m}{\left[2\sin\alpha_m - \left(\frac{\Delta h}{R} \right)^{0,5} \right]} \cdot k \ . \tag{11}$$

At disparity of speeds of purveyance on the output of casting wheel V_c and on included of it in the rolling mill $V_å$, increase of length of purveyance ΔL for the set time t_g without measuring $V_å$, calculate with using a formula

$$\Delta L = \left| V_c - V_å \right| \cdot t_g = \left[V_c - V_r \cdot \frac{F_o}{F_e} \cdot \frac{\sin\alpha_m}{\left| 2\,sin\,\alpha_m - \left(\frac{\Delta h}{R} \right)^{0,5} \right|} \cdot k \right] \cdot t_g \ . \tag{12}$$

It allows to form a proactive correcting signal for by management by work of the casting-rolling module, not waiting for the actual increase of proportions for purveyance, and, due to it, to improve quality of management.

Conclusions. The theoretical formula of drag, which allows with sufficient exactness to define speed of purveyance on included in a rolling mill and to perfect the algorithm of management by work of the casting-rolling module at the production of aluminium rolled wire, is got.

LIST OF LITERATURE

1. Николаев, В. А. Теория и практика процессов прокатки [Текст] / В. А. Николаев. – Запорожье : ЗГИА, 2002. – 232 с. – Библиогр. : с. 224-230. – ISBN 966-7101-42-8.