UDC 621.771

V.A. Nikolaiv, manager by a department, d.t.s., professor
A.G. Vasil′ev, engineer

THE ASSUMED COBBING OF BREAKDOWN BAR IN DRAFT STANDS OF WFHR

Zaporozhe state engineering academy, Ukraine

The maximal cobbings recommend to apply in the rough stands of broad band figures (FHRBB) that allows to use thick slabs, and also decrease thermal losses. The sizes of cobbings of slab (roll) in stands are limited by the different factors, including the assumed corner of claw (by the coefficient of friction), durability of rollers (by force of rolling) and details of main line of stand (by a twisting moment). Determination of the real values of limitations will allow to set the rational regime of cobbings for slab in stands.

Keywords: figure, stand, rolling, roll, cobbing, corner of claw, force

At rolling of breakdown bars in the stands of draft groups of wideband mill of the hot rolling (WFHR) of size of cobbings the horizontal rollers limited by the maximum corner of acquisition, durability of rollers (by force of rolling), twisting moment and power of main drive. The most cobbings are characterized for the first stands, when the temperature of slab has a maximal size (1180-1220 °C). The less absolute cobbings are appointed in the last stands of draft group, when a breakdown bar is characterized comparatively by a small thickness and the least temperature.

Most systematized, in our view, specified method of calculation for the maximum cobbings, is presented in work [1].

The natural acquisition of stripe by rollers takes place at condition [1,2]:

$$\alpha_{à} = f \cdot k_{à} \cdot k_{Q} \ , \qquad (1)$$

where $\alpha_{à}$ is the assumed (maximum) corner of acquisition of breakdown bar rollers; $f_{à}$ is a conditional coefficient of friction at the acquisition of rollers; f is a coefficient of friction in the hearth of deformation at the set process of rolling; $k_{à}$ is a coefficient, taking into account distinction of conditions at the free acquisition of breakdown bar and at the set process of rolling ($k_{à}$ ~1,3); k_{Q} is a coefficient, taking into account the improvement of conditions of acquisition at a diving in rollers of breakdown bar under the action of gravity roll carrier or previous stand.

If a breakdown bar is included in rollers under the action of some force Q from a previous stand with the horizontal (vertical) rollers [2,3,5], then in this case on the appearing area of contact (after the transfer of force $0{,}5Q$ in point middle for length of contact) the normal and tangent forces are operated.

The condition of balance of forces in a horizontal plane has a look:

$$\left(T \cdot \cos \alpha_{à} + 0{,}5\, Q\right) = P \cdot \sin \alpha_{à} \ , \qquad (2)$$

where $Ò$ is tangent force on an area at the free acquisition of breakdown bar; Q is force, operating on a breakdown bar; $Ð$ is force, operating from a breakdown bar on rollers of this stand at a free acquisition.

After dividing of equation (2) on force P and executing some transformations, it is possible to write

$$\alpha_{à} = f_{à} + k_F \ , \tag{3}$$

where k_F is a coefficient, taking into account influence of force, pushing a stripe.

At absent of force Q the known ratio for a free acquisition is takes place $\alpha_{à} = f_{à}$.

Силу Q can define for conditions rolling in a previous stand (taking into account influence of areas of passing and lag) from expression (at $\gamma > 0$ and $\cos\alpha \cong 1$):

$$Q = 2f \cdot P_r \cdot (\alpha - 2\gamma/\alpha) \ , \tag{4}$$

where P_r is force of rolling at the filled hearth of deformation in a previous stand; f, γ, α are a coefficient of friction, corner of critical section and corner of contact in a previous stand, accordingly.

For determination of force $Ð$ in this stand, operating in the moment of acquisition, it is possible to apply a formula

$$P \cong \delta_{m,a} \cdot \ell_a \cdot \hat{A} \ , \tag{5}$$

where $\delta_{m,a}$ is a middle normal contact tension at the acquisition of breakdown bar in this stand; $\hat{A}$ is a width of breakdown bar; $\ell_{à}$ is length of contact arc in this stand in the moment of acquisition of breakdown bar.

Writing force Q in equation (5) through normal contact tension and carrying out the joint decision of equations (4) and (5) at $\alpha - 2\gamma/\alpha$ = 0.05-0.10 get

$$k_F = \frac{Q}{2Ð} = (0.05...0.10)\frac{f \cdot \delta_m \cdot \ell_d}{\delta_{m,a} \cdot \ell_a} \ , \tag{6}$$

where ℓ_d is length of arc of contact in a previous stand; δ_m is middle normal contact tension at rolling in a previous stand.

The assumed cobbing Δh_d is equal [to 1-3,5,6]:

$$\Delta h_d = R \cdot \alpha_{à}^2 = R \cdot f_{à}^2 \cdot , \tag{7}$$

where R is a working radius of rollers; $f_{à}$ is a conditional coefficient of friction from ratio (1).

Meaning that force of rolling practically linearly depends on cobbing, ratio also is offered [6]:

$$\Delta h_d = \Delta h' + \frac{(\Delta h'' - \Delta h')}{P'' - P'} \cdot (P_d - P'), \tag{8}$$

where $\Delta h'$, $\Delta h''$ are accordingly minimum and maximal absolute cobbings, accepted for this calculation; $Ð'$, $Ð''$ are calculation forces rolling, corresponding to cobbing $\Delta h'$ and $\Delta h''$.

For determination of the assumed corner of acquisition, force of rolling and twisting moment, first of all, it is necessary to expect the coefficients of friction (f), tension flow of metal (σ_f), middle normal contact tension (p_m), coefficient of shoulder of moment (ψ), length of contact arc taking into account elastic deformations of rollers and stripe ($\ell_{\tilde{n}}$) and force of rolling ($Đ$). The most reliable and reasonable dependences for the calculation of the indicated parameters, confirmed by practical facts, presented in works [1-3,5,6], which are recommended for the use. For the subsequent calculations of other parameters of hearth of deformation in this stand from all variants of values accept the minimum assumed cobbing.

Conclusions. The improved method of calculation of cobbing on the size of maximum corner of acquisition taking into account the forced giving of breakdown bar in rollers from horizontal force of previous stand is worked out. Ratio for the calculation of horizontal force during deformation of metal in a previous stand is got. It is set that application of the forced input of breakdown bar in rollers results to the increase of maximum corner of acquisition in 1.3-1.4 time.

LIST OF LITERATURE

1. Ніколаєв, В. О. Виробництво плоского прокату [Текст] / В. О. Ніколаєв, В. Л. Мазур. – Запоріжжя : ЗДІА, 2010. – 320 с. – Бібліогр. : с. 310-317. – ISBN 978-966-8462-27-6.
2. Николаев, В. А. Продольная разнотолщинность широких полос [Текст] / В. А. Николаев, А. А. Васильев // Металлургическая и горнорудная промышленность. – 2012. – № 6 (277). – С. 23-27.
3. Николаев, В. А. Теория прокатки [Текст] / В. А. Николаев. – Запорожье : ЗГИА 2007. – 228 с. – Библиогр. : с. 218-224. – ISBN 976-966-7101-86-2.
4. Николаев, В. А. Теория и технология прокатки металла [Текст] / В. А. Николаев. – Запорожье : Акцент Инвест-Трейд, 2013. – 232 с. – Библиогр. : с. 211-216. – ISBN 978-966-2602-49-1.
5. Николаев, В. А. Исследования параметров, способы и устройства прокатки полос [Текст] / В. А. Николаев. – Запорожье : Акцент Инвест-Трейд, 2012. – 264 с. – Библиогр. : с. 245-260. – ISBN 978-966-2602-14-2.
6. Железнов, Ю. Д. Статистические исследования точности тонколистовой прокатки [Текст] / Ю. Д. Железнов, С. Л. Коцарь, А. Г. Абиев. – М. : Металлургия, 1974. – 240 с. – Библиогр. : с. 236-239.