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RESEARCH OF MOVEMENT RATE FOR ALUMINIUM BLANK ON CASTING-RENTAL MODULE

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There is modeled blank movement speed on an ourlet from a casting mashine and inlet in a rolling mill depending on its temperature, coefficients of friction and rolling-out. At the synchronization of casting-rolling module drives it is recommended to take into account the blank temperature which, together with the speed of the casting mashine, determines the initial speed of the blank and significantly affects the friction factor and its speed at the inlet of the rolling mill.
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The obligatory condition of the continuous casting and free rolling of aluminium is constancy of the second volumes for metal on all areas of technological line.

$$V_{cë} \cdot F_{cë} = V_{çàã} \cdot F_{cë} = V_{êàò} \cdot F_{êàò} \ , \tag{1}$$

where $V_{cë}$ – a rate of movement of blank on the outlet of casting machine; $V_{çàã}$ – a rate of movement for blank on inlet in a rolling mill; $V_{êàò}$ – a rate of movement for rod on an outlet from a rolling mill; $F_{cë}$ – an area of section of blank after casting; $F_{êàò}$ – an area of section for rod on an outlet from a rolling mill.

Researches of work of casting machine and rolling mill [2] showed that constancy of the second volumes of metal on the different areas of technological line depended on disturbances which render substantial influence on the forming blank proces, both from the side of casting machine and rolling mill.

After entering of molten aluminium in mould of casting machine there is its crystallization under the action of the forced water cooling, which is accompanied by linear constaction of metal. Speed of blank on an outlet from mould $V_ç$ is determined by both the movement rate for of casting machine $V_{ëì}$ and speed of constaction of metal $V_{óñ}$:

$$V_ç = V_{ëì} - V_{óñ} \ . \tag{2}$$

If speed of constaction for metal V_{yc} to present as $\Delta\ell / \tau$, where $\Delta\ell$ is a size of constaction for metal on the area ℓ of casting machine from the place of beginning of aluminium crystallization to the point of blank output from mould; $\Delta\ell = \ell \cdot c \cdot (T_1 - T_2)$ c, T_1 – a temperature coefficient of linear expansion and temperature of beginning of aluminium crystallization, accordingly; T_2 – a temperature of blank on an outlet from mould; τ – time of turn of casting machine on a corner, limited by the indicated temperature points, that equation (2) assumes a kind:

$$V_{ç} = V_{ëì} - \frac{l \cdot c \cdot (T_1 - T_2)}{\tau} = V_{ëì} \cdot 1 - \tilde{n} \cdot (T_1 - T_2) \ , \qquad (3)$$

where $\ell/\tau = V_{ëì}$ – speed of casting machine.

On the other hand, speed of casting machine can be written down as

$$V_{ëì} = \frac{n_c \cdot \pi \cdot D_c}{60\ i_c} \ , \qquad (5)$$

where n_c - speed of rotation for electrodrive of casting machine; D_c - a diameter of casting machine, i_c - a coefficient of reduction of drive of casting machine, then equation (5) will look like :

$$V_{ëì} = \frac{n_c \cdot \pi \cdot D_c}{60\ i_c} \cdot 1 - \tilde{n} \cdot (T_1 - T_2) \ . \qquad (6)$$

It ensues from equation (6), that at constant speed rotation for electrodrive of the less than, than anymore difference of temperatures $\Delta T = T_1 - T_2$. Because formation of hardcore of blank begins at a temperature T_1 = 600 °C, and its temperature on an outlet from a casting machine changes within the limits T_2 = 450-530 °C [1], speed of blank according to equation (6) hesitates within the limits 0.18 %.

It is known that a blank on inlet in a rolling mill moves with speed:

$$V_{ç} = \frac{V_{êàò}}{\lambda} \ , \qquad (7)$$

where $V_{êàò}$ – speed of rod after rollers of the first cage; $V_{êàò} = V_{â} \cdot (1 + S_{îï})$, $V_в$ – speed of rollers for the first cage, S_{on} – advance; $S_{îï} = \gamma^2 \cdot \left(\frac{R}{h_{âûõ}} - 0,5 \right)$ [2]; γ – a neutral corner; R – radius of roller; $h_{âûõ}$ – a height of blank section after rollers of the first cage, λ - a coefficient of drawing, and also whereas, the value of neutral corner depending on the corner of capture α and corner of friction β and is determined on a formula [2]; $\gamma = 0,5\ \alpha \left(1 - \frac{\alpha}{2\beta} \right)$, it is possible to present equation of speed of blank on inlet in a rolling mill in a kind:

$$V_{ç} = V_{â} \cdot (1 + S_{îï}) \ . \qquad (11)$$

From formula (11) evidently, that at the unchanging values of corner for capture α, radius of rollers R and height of blank section after rollers of the first cage $h_{âûõ}$, speed of her on inlet in a rolling mill depends on the size of coefficient of friction β.

According to work [3], at $T/T_{ïë} \geq 0,5$ dependence of coefficient of friction β from the temperature of metal it is possible to approximate by equation:

$$\beta = 0,6 \cdot k_v \cdot k_c \cdot k_{ãï} \cdot \left(1,07 - 0,73 \frac{T}{T_{ïë}} \right) \ , \qquad (12)$$

where k_v, k_c, $k_{ãï}$ – coefficients, which take into account influence of rolling speed, greasing, material of rollers and band, and also state of their surface; $Ò$ –

температура blank on inlet in a rolling mill, and $\grave{O}_{\text{ïë}}$ – a temperature of aluminium melting.

Then the size of coefficient of friction at rolling, according to a formula (12), changes on 15.7 %, and speed of blank on included in a rolling mill, expected on a formula (11), increases on 2.2 %.

Taking into account dependence (7) on the same size occurs increase of speed of rod on an outlet from a rolling mill.

In accordance with technical descriptions of casting rental modele (CRM) at the production of aluminium rod the vibrations of outlet section of the prepared products are assumed. Depending on a diameter they can change a from ± 0.3 to ± 0.5 mm [1]. It is explained that from inconstancy of physical properties of metal, wear of rollers, «senescences» of greasing and other factors the coefficient of drawing λ, the size of which also has influence on speed of blank before a rolling mill. Reaserchs on the operating casting-rental module showed that at the changes of coefficient of drawing in an interval from 32.8 to 31.83 speed of blank on inlet in a mill increases almost on 3 %.

Thus with use of modeling of movement rate for blank, it is set that at the increase of its temperature and declining of coefficient for drawing caused by instability processes of casting and rolling there is an increase of rate movement of blank aluminium on all areas of technological line, from a casting machine to the coilers. In this connection at perfection of control work of CRM it is necessary to take into account speeds of blank on the outlet of casting mashine and inlet in a rolling mill.

References

1. **Таран, Ю. П.** Исследование температурных деформаций заготовки при непрерывном литье алюминия [Текст] / Ю. П. Таран, А. Н. Николаенко // Металургія : наукові праці Запорізької державної інженерної академії. – Запоріжжя : ЗДІА, 2007. – Вип. 16. – С. 139-144. – Библиогр.: с. 144.
2. **Грудев, А. П.** Теория прокатки [Текст] / А. П. Грудев. – Изд. 2-е, перераб. и доп. – М. : Интермет Инжиниринг, 2001. – 280 с. – Библиогр.: с. – экз.
3. **Кривенцов, А. М.** Коэффициент трения при горячей, холодной и теплой прокатке цветных и чёрных металлов [Текст] / А. М. Кривенцов // Конструирование, расчет и исследование прокатных станов : сб-ик научн. трудов. – М. : ВНИИметмаш, 1987. – С. 76-82.