Impact of rolls position movement during blocks production on continuous-casting machine billets quality

Maria Androsenko

Senior Lecturer
VPO "Magnitogorsk State Technical University named after G.I. Nosov"
Magnitogorsk, Russia
E-mail: androsenko.masha@yandex.com

Vladimir Kadoshnikov

PhD in Technical Sciences, Prof.
VPO "Magnitogorsk State Technical University named after G.I. Nosov"
Magnitogorsk, Russia
E-mail: kvi-51@mail.ru

Irina Kadoshnikova

Senior Lecturer
VPO "Magnitogorsk State Technical University named after G.I. Nosov"
Magnitogorsk, Russia
E-mail: _ii.kadoshnikova@mail.ru

Ekaterina Kulikova

PhD in Technical Sciences, Prof.
VPO "Magnitogorsk State Technical University named after G.I. Nosov"
Magnitogorsk, Russia
E-mail: ee.kulikova@mail.ru

Irina Balandyuk

Student
VPO "Magnitogorsk State Technical University
named after G.I. Nosov"
Magnitogorsk, Russia
E-mail: Domino6718@mail.ru

Abstract
The impact of construction of secondary cooling zone (SCZ) on quality of billet casted by the continuous-casting machine (CCM) is considered in the article. The changes of construction of SCZ allowing the production quality to be increased are presented.
Key words: CCM, SCZ, RHOMBOIDITY, ROLLERS, COORDINATES OF AXES

In 2004, CCM with basic radius of 9 m were put into operation at JSC "Magnitogorsk Iron and Steel Works".

Transition to the continuous casting increased to production quality requirements, that is internal defects (central porosity, central segregation, segregation streamer of crack, bright fringe, edge point contamination, gas cavity) and outer defects (crust, rhomboidity, scratch, side strain, concavity, teeming arrest).

Analysis of data on outer defects of different melted steel grades has shown that geometry defect "rhomboidity" was the highest in percentage ratio to other defects (30-50%).

The greatest rhomboidity of billet (up to 24 mm) was characteristic for casting without supporting rollers consisting of two layers under mold; the rollers were removed after breakout of billets crust for re-stranding acceleration.

As a result of investigation, the conclusions that application of two-layer sections of rollers under SCZ mold incompletely provides output of high-quality products because of a long distance between sections of rollers and low hardness were drawn.

For reduction of loads on hanger elements and as a consequence increase in hardness, reduction of pressure between rollers and billets that leads to billet shape and surface deformation, it was suggested to change hanger design. Three rows of rollers were set in the current sizes of base and brackets.

The device (Figure 1) consists of the following elements: mold 1, to which base the unit SCZ 2 is connected; it consists of the roller sections 3 containing distant 4 and close-in 5 radial and side 6 load-carrying elements. Rollers 7 are arranged on the axes 8 fixed on the common body 9 to the base. Axes 8 of rollers 7 forming radial load-carrying elements 4 and 5, and axes 8 of rollers 7 forming side load-carrying elements 6 in each section are parallel and are arranged at an angle between sections.

In case of design of the SCZ unit, there were difficulties in determination of axes coordinates of SCZ rollers. The technique of determination of shaft axes positioning was developed and the patent [1] for utility model was obtained. According to this patent, coordinates of axes of rollers holes in y-plane form distant b_{yi} (1) and close-in b'_{yi} (2) radial load-carrying elements, which are determined by the following dependences:

$$b_{yi} = i \cdot 1{,}5d \tag{1}$$

$$b'_{yi} = \frac{b_{yi} \cdot (2R + d)}{2 \cdot (R - L) - d} \tag{2}$$

Coordinates of axes of rollers holes in x-plane form distant b_{xi} (3) and close-in b'_{xi} (4) radial load-carrying elements are determined according to the axis perpendicular to the base from the middle of strand by the following dependences:

$$b_{xi} = \frac{L}{2} + \frac{d}{2} + b_{yi} \cdot sin\frac{2 \cdot sin^{-1}\frac{b_{yi}}{2\cdot(R-L)-d}}{2} \quad (3)$$

$$b'_{xi} = \frac{L}{2} + \frac{d}{2} - b'_{yi} \cdot \mathrm{tg}\frac{2 \cdot sin^{-1}\frac{b_{yi}}{2\cdot(R-L)-d}}{2} \quad (4)$$

where *i*– serial number of section; *d* – rollers diameter; *R* – radius of continuous-casting machine; *L* – size of cast billet.

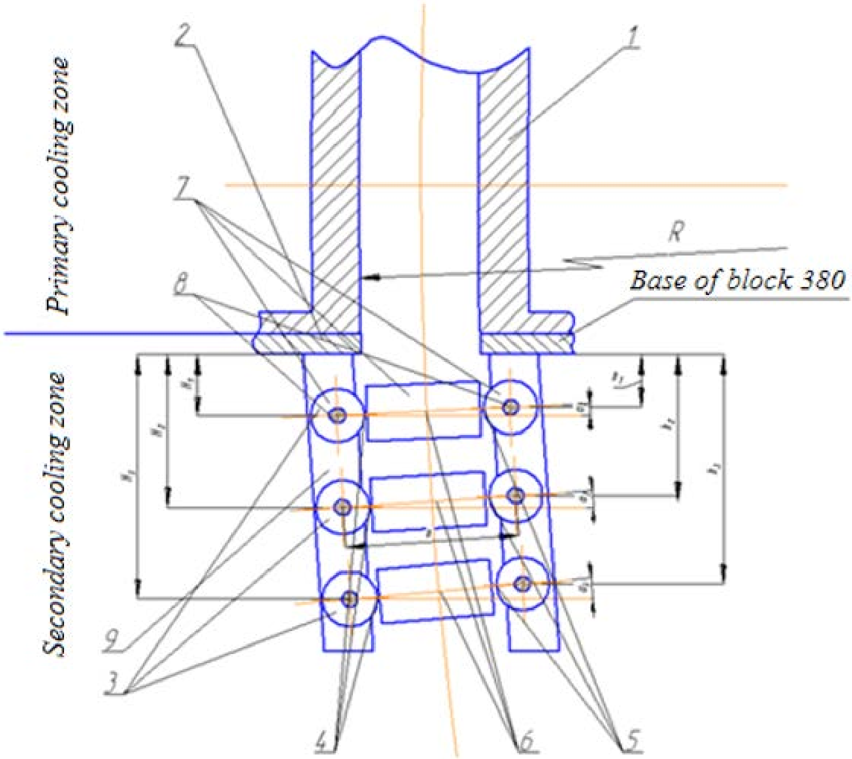

Figure 1. SCZ design with three sections of rollers

The construction of roller block with additional section of rollers is designed, developed and passed industrial tests by continuous-casting machine of MSP JSC "Magnitogorsk Iron and Steel Works". The billet quality was increased by 15-20% due to reduction of rhomboidity.

References

1. Patent PM 105 849 RF. The device for holding of ingot in the secondary cooling zone of continuous casting machine. Kadoshnikov V.I., Zakharov I.M., Aksenova M.V. et al., publ. 27.06. 2011. Bulletin No 18.
2. Aksenova M.V., Mezin I.Yu. (2012) Influence of a chemical composition and casting technique on billet quality of CCM of MSP "MISW". *Aktual'nye problemy sovremennoy nauki, tekhniki i obrazovaniya* (*Actual problems of modern science, technology and education: materials of the 70th interregional scientific and technical conference*). Magnitogorsk, Magnitogorsk State Technical University named after G.I. Nosov, Vol. 1, p.p. 312-315.
3. Androsenko M.V., Kharlov D.A., Kadoshnikov V.I., Kulikova E.V., Kadoshnikova I.D. Integral Assessment of Quality Continuous Cast Billet Caster. *EAF Pnm Eastern European Scientific Journal.* AURIS Kommunikations – und VerlagsgesellschaftmbH 2014. Available at: www.auris-verlag.deDOI 10.12851/EESJ201406.
4. Aksenova M.V., Kvasova N. A. (2013) Influence of the technological personnel on quality indicators of work of casting section of CCM of MSP JSC "MISW". *Nauchno-tekhnicheskiy vestnik Povolzh'ya*. No 4, p.p. 94-98.
5. Aksenova M.V., Kadoshnikov V.I., Kulikov S.V., Kulikova E.V., Kadoshnikova I.D. (2009) Analysis of modern methods of maintenance of the metallurgical equipment. Journal of Mag-

nitogorsk State Technical University named after G.I. Nosov. No3, p.p. 61-65

6. Aksenova M.V., Katerinina I.A.,Kadoshnikova I.D. (2013) Forecasting of billets quality obtained be the technique of continuous casting by application of fuzzy-sets theory. *Mekhanicheskoe oborudovanie metallurgicheskikh zavodov*. Magnitogorsk, Magnitogorsk State Technical University named after G.I. Nosov, No 2, p.p. 52-55.

7. Skurikhina E.B., Kochukova O.A. (2015) Computer technologies in teaching graphic disciplines. Topical questions and answers. *Arkhitektura. Stroitel'stvo. Obrazovanie* (*Architecture. Building. Education: Proceedings of the international scientific-practical conference*). Magnitogorsk, Magnitogorsk State Technical University named after G.I. Nosov, No 2 (6), p.p. 207-212.